

# **(Re)framing sustainable transitions:**

Perspectives from a city in the Global South

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## Abstract

This study analyses the conditions under which socio-technical systems transition to more sustainable configurations. It does so through an exploration of the City of Cape Town's electricity distribution arrangements. This investigation is situated within debates on sustainable socio-technical transitions in general and the multi-level perspective (MLP) in particular.

This study considers four themes that are important for understanding the conditions under which socio-technical regimes change - regulation, organisations, geographical context and scale. These themes structure an empirical study of an energy transition in a city (scale) in the Global South (geographical context) and an examination of the role of regulatory and organisational conditions in shaping sustainable transitions. In turn, the implications of this case for transition theories is explored.

The site of the study is a local government in an African city, Cape Town. This southern geography offers unique conditions, particularly related to the ways in which the technical interacts with the social, in conditions where poverty and inequality are prevalent. In exploring the City's electricity system, field-work was undertaken using a participatory, engaged and grounded theory approach. Notably, research was conducted within a knowledge co-production setting that involved spending three years in the City, embedded in its Energy and Climate Change Unit. This provided invaluable access to the tacit knowledge of practitioners and a unique view into the internal workings of the City.

The results of this field-work have implications for sustainable transition theory. In the City, systemic tensions and contestation were prominent in relation to the incumbent electricity system. Notably, it was found that reconfiguration agendas, represented in the City's Energy and Climate Action Plan, are disrupting developmental values, such as cross-subsidisation, which underpin the incumbent electricity system. Accordingly, regime reconfiguration based on environmental values competes with developmental values embedded within incumbent regime structures. This provides the basis for conceptualising socio-technical transitions as conflicts related to contested values. These value tensions are repeated across scales, manifested by contestation between urban energy autonomy and security on the one hand and national developmental transitions on the other.

The presence of systemic value tensions in the City also has a bearing on the conditions and pathways for socio-technical transitions. In this regard, this study applies a constructivist approach to exploring socio-technical reconfigurations through identifying two broad energy trajectories that

the City is able to pursue; a centralised or distributed trajectory. This informs a heuristic to explore the socio-economic outcomes of reconfigurations. It further identifies potential reconfiguration processes present in the City that forms the basis of alternative theoretical reconfiguration typologies that are cognisant of value contestations.

Through evaluating formal rules that regulate the City's electricity system, this study finds that regulatory systems are used as a tool to assimilate, codify and stabilise dominant value sets into socio-technical regimes. Further, it was found that separate City departments are aligned to divergent socio-technical values. Thus, competing values create contestation within organisations in framing transition processes.

Overall, the study offers an alternative conceptualisation of socio-technical regimes as systems produced and reproduced through value contestation. By drawing on the case of the City's electricity system, the study provides evidence to show that value tensions related to socio-technical regimes are played out in regulatory, organisational and political landscapes. The study thus argues that these competing value systems are integral in the co-evolutionary process of regime configuration and reconfigurations.

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## List of acronyms

ACC	African Centre for Cities
AMEU	Association of Municipal Electricity Undertakings
ANT	Actor Network Theory
CCT	City of Cape Town
CESU	Cities Energy Support Unit
CSGT	Closed Cycle Gas Turbine
DOE	Department of Energy
ECAP	Energy and Climate Action Plan
ECC	Energy and Climate Change
EE	Energy Efficiency
EEF	Energy Efficiency Forum
EESP	Economic, Environmental and Spatial Planning
EMT	Executive Management Team
ERC	Energy Research Centre
ERMD	Environmental Resource Management Department
ESCO	Energy Services Company
ESD	Electricity Services Department
GT	Grounded Theory
IDP	Integrated Development Plan
IPP	Independent Power Producer
IRP	Integrated Resource Plan for Electricity
IMEP	Integrated Metropolitan Environmental Policy
MLP	Multi-Level Perspective
MFMA	Municipal Finance Management Act
MUF	Mistra Urban Futures
MSA	Municipal Systems Act
MYPD	Multi-Year Price Determination
NBR	National Building Regulations
NERSA	National Energy Regulator of South Africa
OEF	Optimum Energy Future
PBDM	Planning and Building Development Management
PE	Political Ecology

PPA	Power Purchase Agreement
PV	Photovoltaic
RE	Renewable Energy
REDP	Resource Efficient Development Policy
REEEP	Renewable Energy and Energy Efficiency Partnership
REIPPP	Renewable Energy Independent Power Producer Procurement Programme
RPS	Renewable Portfolio Standard
SCM	Supply Chain Management
SSEG	Small-scale Embedded Generation
SABS	South African Bureau of Standards
SACN	South African Cities Network
SALGA	South African Local Government Association
SEA	Sustainable Energy Africa
SNM	Strategic Niche Management
SPU	Strategic Policy Unit
SPUD	Spatial Planning and Urban Design
SWH	Solar Water Heater
STS	Socio-Technical System
UPE	Urban Political Ecology

## Chapter 1: Introduction

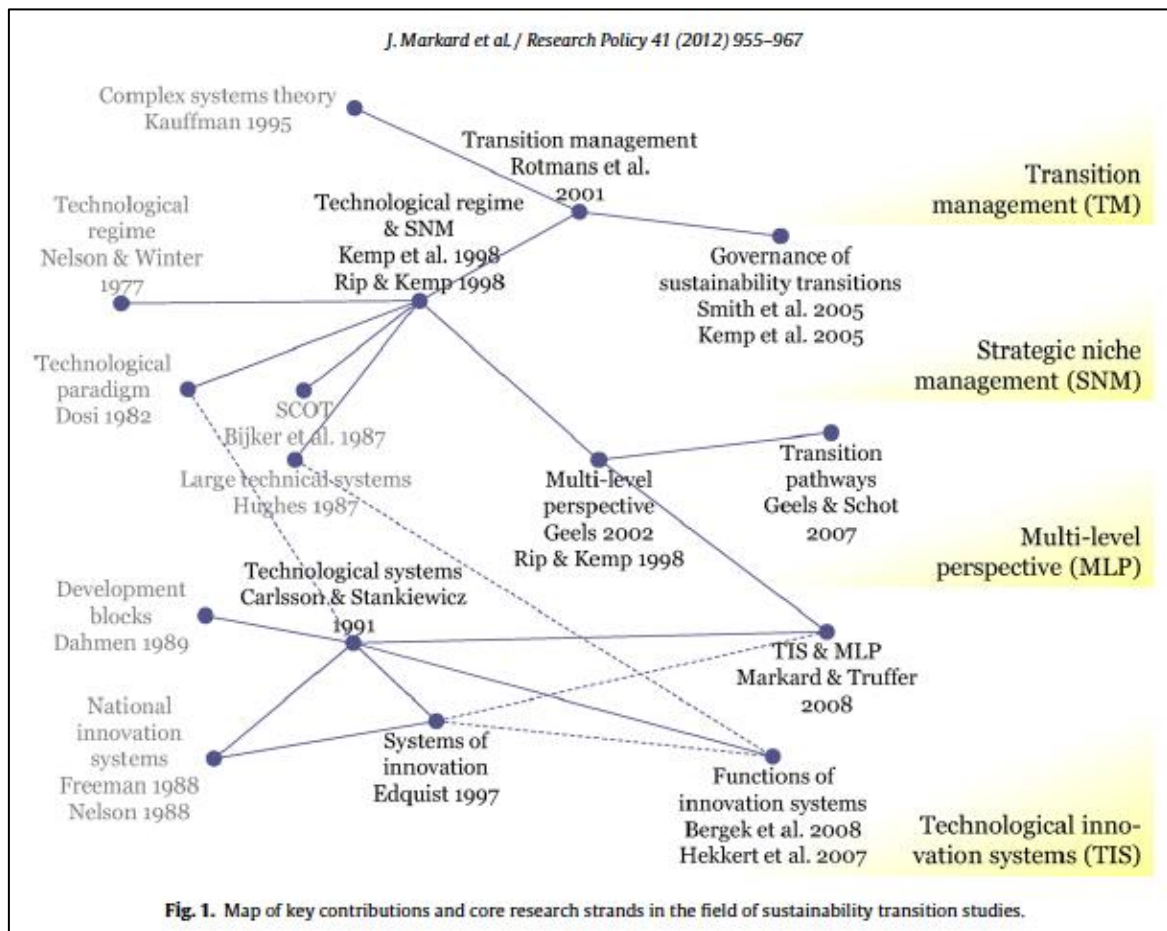
### 1.1. Situating the study: Sustainable transitions and the multi-level perspective

This thesis is concerned with the conditions under which complex socio-technical systems transition to more sustainable configurations. It seeks to examine an urban electricity system, a socio-technical regime that sits at the intersection of a self-reinforcing poly-crisis related to energy, climate change and infrastructure. The context of the study is a local government in an African city. This southern geography offers unique conditions, particularly related to the ways in which the technical (infrastructure) interacts with the social, in conditions where poverty and inequality are prevalent. Apart from a focus on geographical context (Global South) and scale (urban), this thesis explores regulatory and organisational conditions in relation to sustainable transitions and the governance of transitions.

It is widely held that infrastructure transitions are required to address intersecting challenges related to climate change, poverty and urbanisation. Further, such change is needed at a rate faster than typical long-term technological evolution (Rip and Kemp, 1998; Geels and Schot, 2007). The immutable nature of large technical systems thus becomes problematic when confronted with an urgent need for change (Hodson, 2008; Kemp and Loorbach, 2006). In the past decades, a field of research has arisen that aims to understand how more sustainable socio-technical configurations may be established (Kemp et al., 1998; Schot, 1992). This field of enquiry has become known as sustainable transition theory. In particular, various frameworks have gained prominence in transition studies including; transition management (Kern and Smith, 2008; Loorbach, 2010; Rotmans et al., 2001), strategic niche management (Kemp et al., 1998; Raven and Geels, 2010; Smith, 2007), and technological innovation systems (Jacobsson and Johnson, 2000).

More recently, Dutch scholars have developed the multi-level perspective (MLP) on socio-technical transitions (Geels, 2002; Geels and Schot, 2007b; Smith et al., 2010) in order to analyse socio-technical systems and the conditions under which they change in the context of wider social, political and economic dynamics (Rip and Kemp, 1998; Rip, 1995; Geels, 2004; Geels, 2010). According to the MLP, socio-technical transitions occur in instances where regimes confront multiple systemic pressures that compel change and nascent technologies ('niche innovations') providing pathways for change (Geels, 2004). Unlike long-term co-evolutionary processes, this disruption is dramatic (Rip and Kemp, 1998). The MLP is thus particularly apt for explorations of rapid transitions (Smith, 2005) and the 'possibility of accelerating transitions' (Kemp et al., 1998; Kemp, 1997).

Figure 1.1. Map of key contributions and core research strands in the field of sustainability transition studies (Markard et al., 2012)



Further, several frameworks, that similarly seek to understand sustainable change, have emerged from sustainability science or related research, including resilience theory, ecological modernisation (Sonnenfeld, 2000) sustainable or eco-innovation (Rip, 1995), industrial ecology, political ecology, urban political ecology and multi-level climate governance. This study is situated within the nexus of these debates, with a particular focus on socio-technical transition theory and the MLP.

## 1.2. Sustainable infrastructure and energy transitions

Sustainable transition theory in general and MLP in particular offer a useful lens for analysing network infrastructure. This is due to their roots in the study of large technical systems (Coutard, 1999; Geels, 2004) and evident from the considerable body of cases that focus on network infrastructure (Rip and Kemp, 1998; Kemp, 1994; Smith et al., 2005). Electricity networks in particular are well suited to exploration through a socio-technical systems lens. They are easily classified as regimes that are deep-rooted and comprised of tightly connected technical, regulatory and institutional elements that enjoy steady investment flows and end-user support (Smith, 2007a;

Verbong, 1999; Verbong and Geels, 2007; Raven, 2004). However, there are a number of important contextual issues that have not been fully considered together in socio-technical transition studies that focuses on electricity systems.

First, it is evident that rapid transition processes related to electricity are happening in reality, in diverse contexts, on a global scale. Transitions, as described in theory (Geels, 2004; Rip and Kemp, 1998), are well under way and occurring at a rate exceeding predictions (Bailey and Wilson, 2009; International Energy Agency, 2014, UNEP, 2011). This has been labelled 'the renewable energy revolution' (REN21, 2014) or the 'third industrial revolution' (Rifkin, 2011). Notably, the largest change in electricity regimes is expected to come from distributed energy. Models predict that by 2040 distributed solar will be cheaper than grid electricity in every major economy (Worldwatch Institute, 2014). This lays the foundation for an entirely different electricity system based on 'democratisation of supply' (Alarcon-Rodriguez et al., 2010; Lueken et al., 2012; UNEP, 2012). Conversely, this 'energy revolution' is placing a convergence of disruptive challenges on traditional utility models. In brief, distributed energy and efficiency technologies (niche innovations) are becoming increasingly cost competitive. There is also growing regulatory and political support for these technologies (Smith, 2007a; Verbong and Geels, 2007, UNEP, 2011). At the same time, the costs of conventional grid electricity are rising (World Bank, 2015). Customers are responding to these price increases by improving efficiency and installing distributed energy, which results in reduced electricity sales and revenue for utilities (NARUC, 2007). Electricity regimes accordingly confront system-wide challenges to the ways in which they have operated in the past (Avrabos, 2014; International Energy Agency, 2014). In the language of the MLP, electricity regimes are faced with multiple landscape pressures stemming from niche competition.

Second, electricity systems sit at the intersection of multiple challenges related to inequality, climate change, justice and poverty (Monstadt and Wolff, 2015). Energy use is responsible for approximately two-thirds of global emissions (International Energy Agency, 2014) with electricity generation responsible for the largest share (UNEP, 2012). Thus, consumption of fossil fuels in the Global North has been largely responsible for climate change (Goldthau and Sovacool, 2012; Gore, 2006). Although the contribution of the Global South in general, and Africa in particular, to global emissions is marginal, the Global South is most vulnerable to climate impacts (Cock, 2007; Bond, 2011; World Bank, 2015). Climate mitigation and hence the sustainable transition of global electricity systems thus raise issues of equity, climate justice and fairness (Barrett, 2013; Bond, 2013; Page, 2007; Goldthau and Sovacool, 2012). Yet, sustainable energy transition studies seldom examine the tension between development, justice and environmental aspects of energy transitions.



Further, current trends in restructuring and privatisation of electricity infrastructure (Malgas and Eberhard, 2011; Monstadt, 2009) are not sufficiently explored in sustainable energy transition research. The social rationale behind the establishment of centralised electricity networks was partly the provision of a public good and to ensure universal electricity provision (Graham and Marvin, 2001). However, over the past two decades electricity infrastructure, across the Global North, has been moving away from a state-owned model towards a competitive and privately-owned industry (Monstadt, 2009; Eberhard, 2005; Gratwick and Eberhard, 2008). In the Global South hybrid power markets have emerged alongside widespread privatisation (Eberhard, 2010). In developing countries that have undertaken rapid liberalisation of electricity markets; in many cases this has contributed to the erosion of the 'public good' function of electricity networks, resulting in unequal provisions of services (Pieterse, 2008). Of particular relevance, governments across the developing world have established cross-subsidy systems whereby wealthy electricity users subsidise the poor, to ensure electricity access and affordability (Prasad, 2008; Büscher, 2009; UNDP, 2010). These welfare systems may become 'disrupted' as a result of restructuring. This has not been comprehensively studied by sustainable transition scholars. There is accordingly value in exploring reconfigurations of network infrastructure where systems of cross-subsidisation are present.

The above provide unique variables for examining electricity transitions in a city in the Global South. These variables include systemic challenges to existing electricity infrastructure stemming from niche technologies; erosion of welfare systems alongside restructuring and privatisation of network infrastructure; and intersecting climate and developmental challenges related to electricity systems. These provide a broad background to this study and underpin its rationale.

### 1.3. Rationale for study

It is evident that there are limited empirical studies that focus on energy transitions in cities in the Global South. Alongside this, sustainable transition theory and the MLP do not adequately consider four themes, together, that may be conceptually important in understanding the conditions under which socio-technical regimes transition to more sustainable domains. These are regulation, organisations, geographical context (Global South) and scale (cities). These limitations, in both focus and in empirical basis, in transition theories are highlighted below and explored in greater detail in the conceptual framework developed in Chapter 2.

### 1.3.1. Sustainable transitions in the Global South

It has been argued that sustainable transition studies seldom contextualise and analyse socio-technical systems and transitions within space or time, particularly within ‘contexts of socio-economic diversity’ (Hendriks, 2008). Meadowcroft (2009) queries whether socio-technical transition theory is at all applicable to contexts other than the Global North and predicts that it would need to be hybridised when tested in different geo-political and socio-economic contexts. Lawhon and Murphy (2011) submit that ‘if socio-technical transition theory is to have greater relevance to a wider audience it is critical for its promoters to diversify the range of case studies analysed’ (Lawhon and Murphy, 2011: 363). Notably, transition research has typically been dominated by European and American studies until recent efforts by scholars such as Murphy (2015), Swilling and Annecke (2012), Lawhon and Murphy (2011) and Silver and Marvin (2016) to extend cases to Global South contexts. Moreover, it has been argued that sustainable transition theory pays insufficient attention to the ways in which structures of power and resource control are produced and reproduced (Genus and Coles, 2010; Murphy, 2015) and the ways in which particular technologies are ‘constructed and employed’ (Lawhon and Murphy, 2011: 360). It is arguable that conditions present in the Global South may provide greater scope for investigating issues of power and resource control in reconfiguration processes.

Exploring sustainable transitions in Global South contexts further requires cognisance of critiques on sustainability science and governance frameworks related to their Global North origins and associated biases. These include an inherent techno-optimism (Huesemann and Huesemann, 2011) and belief that sustainability can be achieved through technical fixes (Meadowcroft, 2005); a failure to properly critique the dominant economic paradigm in relation to its incompatibility with sustainability; a bias towards environmental considerations to the exclusion of social sustainability (Agyeman et al., 2013) and a neglect of transitions with critical cultural and political considerations (Genus and Coles, 2008). The shortfalls in sustainability research, governance and policy, attributable to their Global North origins, have been widely criticised particularly by political ecologists (Swyngedouw et al., 2002; Watts and Peet, 2004; Escobar, 1998), de-growth theorists (Fournier, 2008; Demaria et al., 2013) and social ecologists (Gare, 2000; Foster, 1999).

Specifically, conditions in the Global South in relation to sustainable electricity reconfigurations deserve particular attention. Notably, energy poverty and inequality subsists globally on a massive scale (Sanchez and Scott, 2010; Goldthau and Sovacool, 2012). Access to reliable, affordable and modern energy services is crucial for poverty alleviation and development (Carley et al., 2011; Eggoh et al., 2011). Nevertheless, the International Energy Agency (2014) estimates that

approximately 1.3 billion people do not have access to electricity. Approximately 45% of those without access are in sub-Saharan Africa (UN-Habitat, 2011). There is thus value in examining transitions in contexts with widely different electricity policy priorities related to development and poverty alleviation. This further provides an opportunity for closer investigation into political economy, socio-economic and socio-spatial aspects of electricity infrastructure and impacts of reconfigurations on social sustainability.

### 1.3.2. Urban scale in the multi-level perspective

Hodson and Marvin (2009b) hold that although the MLP recognises the importance of investigating nested interrelationships, spatial scales related to transitions are often implicit and underexplored. In particular, there is an inherent bias towards the national level as the sites where regimes and hence transitions occur. In response, a number of scholars have argued that the MLP should pay greater attention to cities (Hodson and Marvin, 2009a; Hodson and Marvin, 2010; Coenen and Truffer, 2012).

Notably, there is value in exploring electricity networks on an urban scale in general and from the perspective of a city in the Global South in particular. Cities confront a multiplicity of electricity-related challenges that may provide valuable insight for the MLP and transition studies. Cities are responsible for approximately 70% of global greenhouse gas emissions (UN-Habitat, 2011). Yet, cities in the Global South have far lower per capita emissions when compared to Global North counterparts (Sovacool, 2012; Winkler et al., 2009; Eggoh et al., 2009). Nevertheless, cities in the Global South are far more vulnerable to climate impacts (Bulkeley and Betsill, 2005; Dhakal, 2004; UNEP, 2011). Further, cities in the Global South confront severe urban energy poverty, energy insecurity, ageing infrastructure and health impacts associated with unsafe fuel sources (World Health Organisation, 2014; World Bank, 2015; Alber and Kern, 2008). Alongside this, cities in the Global South are witnessing rapid urbanisation (Pieterse, 2011; Myers, 2011; UNDP, 2010). Over 90% of global urban population growth is taking place in the Global South (Parnell and Pieterse, 2014; UN-Habitat, 2011), predominantly in urban slums with considerable deficiencies related to equity, governance and infrastructure (Huchzermeyer, 2011). These intersecting challenges of urbanisation, infrastructure access and climate change (IPCC, 2014; Holgate, 2007; Myers, 2008) provide a unique context in which to explore the conditions under which regimes change. There is thus value in investigating sustainable transitions of urban electricity regimes in the Global South.

Nevertheless, an urban lens brings up important questions related to capacity and control over urban electricity infrastructure. Authority over electricity systems is usually hierarchal in terms of jurisdictional capacity (Rutter and Keirstead, 2012; Páez, 2010; Smith, 2007a). Electricity systems

have traditionally been centrally controlled by national utilities. Thus, local governments have historically had limited control over electricity systems and little influence in shaping corresponding rule systems (Dhakal, 2004; Monstadt, 2007; O'Brien and Hope, 2010). Conversely, there is a growing trend of cities advocating for increased autonomy related to electricity infrastructure (Bulkeley and Betsill, 2005; Bulkeley and Kern, 2006; Hodson and Marvin, 2010). In practice, municipalities across the globe are engaging in the sustainable reconfiguration of energy infrastructure. In the language of the MLP, urban energy and climate challenges are being increasingly articulated by municipalities as landscape pressures to act (Hodson and Marvin, 2009b). There is accordingly a strong basis for investigating urban electricity transitions. In particular, insight may be gained from investigating issues of authority, mandates, regulatory control and tensions between spheres of government during transition processes.

### 1.3.3. Regulation in transition research

Analysis of regulation and regulatory authority are critical to understanding the reproduction of regimes and the conditions under which they change. Regulation plays a considerable role in influencing sustainable socio-technical change (Holley et al., 2011; Haines, 2011; Holley and Gunningham, 2011; Cullinan, 2002; Geels, 2004). In particular, regulation plays a critical role in the reconfiguration of electricity systems. This is due to the fact that electricity regimes are predominantly natural monopolies typically subject to regulatory oversight (Jamassb and Pollitt, 2008). Importantly, regulatory reform has been used to support sustainable energy transitions across the globe (Newbery, 1995). Regulation is a critical tool in mainstreaming renewable energy niches through instruments such as renewable energy portfolio standards, feed-in tariffs or competitive bidding systems (Eberhard, 2005) and is used to facilitate distributed energy, demand-side management and energy efficiency (Verbruggen and Lauber, 2012). Despite the significant impact regulation has on shaping regimes in general and electricity regimes in particular, sustainable transition cases seldom systematically examine the role of formal rules in inhibiting or facilitating socio-technical change within particular contexts (Stenzel and Frenzel, 2008). According to Genus and Coles:

The making or unmaking of the various types of rules constraining or enabling actions and the reproduction or related practices central to maintenance or transformation has not been an explicit object of systematic study in multi-level perspective research (Genus and Coles, 2008: 1442).

This gap provides an opportunity to explore a number of sub-themes. First, there is value in examining the role of rules in reproducing regime dominance and shaping processes of change. Second, the interactions between rules and other regime elements have been under-explored by

MLP scholars. Third, the role of rules in enabling or restraining capacities to act has been neglected. Related, MLP studies seldom investigate rules in organisational settings. Accordingly, there is value in interrogating processes of interpretation and negotiation of rules related to socio-technical regimes, within organisations that are involved in regime reproduction and change. Finally, there is divergence of opinion on the extent of agency in interactions with rule systems amongst MLP scholars. Smith et al. (2005) thus argue that the MLP can benefit from an analysis of rules in relation to rational choice, capacity and agency. There is thus value in investigating interactions between actors and rules and the extent to which actors influence rule systems.

An examination of regulation is particularly relevant in relation to urban transitions, whereby regulatory authority over network infrastructure tends to be concentrated at the national level and local governments have limited mandates related to socio-technical infrastructure yet are advocating for greater regulatory control. This specifically provides opportunities to explore interactions between regulation, government hierarchies and urban socio-technical infrastructure regimes.

#### 1.3.4. Organisations and the multi-level perspective

There has been limited attention paid to organisations in the MLP. This is despite its origins in innovation studies, which focused predominantly on firms and various organisational elements of technical systems. Analysis of organisations, besides innovation firms operating on the niche level, has been largely absent in the MLP (Breschi and Malherba, 1997). Geels (2004) submits that the MLP has not properly analysed the role of organisations in influencing reconfigurations. This is problematic, as analysis of organisations is critical in understanding the transformation of network infrastructure (Pollitt, 2007) in general and electricity systems in particular (Tankha et al., 2010). Specifically, research has not thoroughly investigated the role of organisations that are responsible for the maintenance and reproduction of infrastructure and hence have the ability to leverage widespread regime change (Honig et al., 2015). These organisations may act as levers for influencing change within the wider socio-technical landscape and hence deserve greater investigation.

Notably, analysis of government organisations and their role in influencing change, incubating niche innovations and engagement with rules that either inhibit or support transitions has been largely ignored in the MLP. This oversight is surprising, as government organisations are often intimately involved in the reproduction of regimes. Exceptions are Smith (2004) and Rotmans and Kemp (2001). Smith et al. (2005) describes the role of certain government institutions in transitions and

highlights the potential for strategic interventions within government policy aimed at steering or facilitating transitions. Rotmans and Kemp (2001) argue that government can play multiple roles in transition processes including initiating, facilitating or directing transitions. Thus, exploring a transition from the vantage point of a local government provides unique opportunities to explore the role of the state in niche incubation, innovation and wider transition processes.

Correspondingly, the MLP does not consider the impact that organisational factors have on reproducing or transforming regimes and the internal drivers and pressures which influence both organisational and wider socio-technical change. Factors such as organisational functions, structures, cultures and power of different 'social groupings' have been largely ignored in examining regime change. This is a notable gap, as these organisational factors heavily influence the motivation for socio-technical change, the capacity for governing change and the success of managing change (LaBelle, 2012). Inversely, inappropriate organisational structures (Sovacool, 2011) and conflicting cultures within government organisations have been identified as significant barriers to sustainable transitions. In relation to urban transitions, studies likewise seldom explore organisational structures and cultures within municipalities and the extent to which these constrain and enable socio-technical change. Accordingly, an evaluation of organisational contexts, within a municipality, can potentially offer fresh insight into the conditions under which regimes change.

#### 1.4. Aims and research questions

The above four themes, namely; regulation, organisations, geographical context (Global South) and scale (cities) provide an entry point for a contribution to sustainable transition theory and accordingly form the rationale of this study. The broad research enquiries of this thesis are thus:

1. Assess the significance and implications of examining a socio-technical energy transition in a city in the Global South for sustainable transition theory.
2. Examine conditions, pathways and governance of regime reconfigurations in cities in the Global South.
3. Examine the relationship between regulation (rules systems) and urban socio-technical regimes.
4. Evaluate the role of municipalities and organisational conditions present in municipalities in shaping sustainable transitions.

#### 1.5. The site and method of the study

In order to navigate the above research enquiries and themes a mixed research strategy was adopted. Primarily, a case study was deemed necessary in order to investigate transitions of an urban energy regime from the perspective of a municipality in a city in the Global South. In selecting

a particular city to study in depth, the City of Cape Town was regarded as suitable for several reasons.

First, Cape Town's energy system is currently locked into an unsustainable configuration, with relatively high per capita emissions and an almost complete reliance on fossil fuels (CCT, 2011c). Conversely, the City has an official policy and implementation track-record that illustrates an intention to facilitate change in its energy system. These intentions are framed within a range of policies including the Integrated Development Plan (2012a) and the Energy and Climate Change Strategy (2006d). Notably, in 2010 the City adopted an Energy and Climate Action Plan (ECAP) that links energy and climate change issues to Cape Town's development strategy (CCT, 2010a).

Second, Cape Town confronts a range of energy-related challenges particular to the Global South. These include widespread energy poverty, inequality, the use of dangerous fuel sources and disproportionate expenditure on electricity by low-income households (SEA, 2010; SEA, 2014a, CCT, 2012a).

Third, the City is subject to a complicated regulatory framework related to electricity, which constrains the capacity of an autonomous urban energy transition. Eskom, the national utility, has exclusive control over electricity supply and transmission (DOE, 2011d; Electricity Regulation Act, 2006). Conversely, the City has comprehensive electricity distribution rights provided for in the Constitution, 1996; Municipal Systems Act, 2000 and the Electricity Regulation Act, 2006. Further, a suite of regulations has been introduced that provide the City with a greater mandate over its distribution system. Accordingly, the City has a degree of, albeit limited, authority related to energy infrastructure.

Four, a strong set of organisational factors related to energy are present in Cape Town. The City has taken a range of steps to establish institutional structures to coordinate energy and climate responses, including the establishment of political and administrative structures (CCT, 2011b). Cape Town is also home to a large number of not-for-profit organisations and research agencies that engage with sustainable energy development. Accordingly, the institutional capacity for managing a sustainable energy transition is present both within local government (City of Cape Town) and Cape Town.

On the other hand, the problems associated with using Cape Town as an example of an African city or a city in the Global South is widely recognised (McDonald, 2008). In brief, many features typical of Global South or even African urban socio-technical regimes may not be adequately represented in Cape Town, including the extent of formal housing and infrastructures, and resource availability

and abundance. These were reflected upon and weighed against the benefits of using the City of CT as a case.

In exploring the City, field-work was undertaken using a participatory, engaged and grounded theory (GT) approach. Notably, research was conducted within a knowledge co-production setting as part of a Knowledge Transfer Programme (Greyling et al., 2016; Patel et al., 2015; Soal, 2014). . Knowledge co-production is an experimental method of co-generating knowledge, between researchers and practitioners, in order to develop policy responses to wicked, non-linear challenges. This involved spending three years in the City, embedded in its Energy and Climate Change Unit undertaking applied research of relevance to both the above research themes and to practitioners. This knowledge co-production process was suited to the theoretical aims of this study. Importantly, a foundational rationale of co-production stems from critiques related to the limitation of less engaged research methods for exploring complex and interdisciplinary themes (Brown-Luthango, 2013; Gibbons, 2000; Patel et al., 2015). As a method, co-production shares an underlying grounding in complexity with transition theory. Notably, transition scholars (Genus and Coles, 2008) in general and urban transition theorists (May and Perry, 2006; May, 2011; Pieterse, 2014; Greyling et al., 2016) in particular recurrently highlight the value of excavating the rich tacit knowledge of practitioners in exploring complex infrastructure systems.

## 1.6. Thesis roadmap

In exploring the themes of this study this thesis is organised as follows. Chapter 2 builds a theoretical framework for the above themes through a literature review of the conceptual underpinnings of sustainable transition theory and the MLP and comparisons with similar interdisciplinary frameworks related to sustainable change. The conceptual framework then discusses the ways in which transition theories cover the four themes of this study; scale (urban), geographical context (Global South), regulation and organisations, alongside other relevant frameworks that theorise on these themes.

The following chapter (Chapter 3) sets out the methodological framework for this study. In particular, it motivates the use of a combination of a case study, grounded theory, participant observation and knowledge co-production as an appropriate methodological strategy for investigating socio-technical regimes.

Subsequently, Chapter 4 provides a brief context of the site of this study, the City of Cape Town (local government). This expands on the rationale for choosing the particular site and provides relevant background, in relation to the themes of this study, to the site.



This is followed by four ‘results and discussion’ chapters that roughly correlate to the four themes of this study. The first, Chapter 5, investigates the theoretical and practical challenges related to exploring a socio-technical infrastructure regime in a city in the Global South. Through analysis of empirical evidence, it seeks to (re)frame socio-technical systems as systems of values<sup>1</sup> that are shaped by geographically contextual socio-economic conditions. This leads to a broader discussion on place-based, rather than universal, definitions of sustainable transitions.

Chapter 6 expands the above argument and offers insights into two areas of concern sustainable transition theory, namely pathways and governance of regime change. First, it outlines historical reconfigurations in the City’s electricity regime. This is followed by an exploration of theoretical typologies and pathways of future regime change in the City. These highlight features of transitions in Global South contexts. Second, it identifies and describes characteristics of governing transitions in the Global South that appear to be different from reflexive governance modalities with their origins in the Global North.

The subsequent chapter (Chapter 7) examines regulation and its function in socio-technical system stability and change. It identifies and evaluates ways in which rule systems constrain and enable reconfiguration processes and examines how rules are produced, used, interpreted and changed by organisational actors. Through this, it offers a conceptual model to describe the multiple roles regulation play in reproducing regimes and facilitating sustainable transitions.

The final results chapter (Chapter 8) evaluates organisational conditions related to socio-technical regimes and explores issues of politics and power in transition processes. In the former task it examines the ways in which organisational functions, structures, cultures and risk impact on transitions. The latter evaluates power and politics in the City’s transition processes and situates this within debates in transition studies and sustainability science related to structure and agency and politics and power.

Finally, Chapter 9 provides a conclusion and synthesis of the conceptual contributions of this thesis to sustainable transition theory. Overall, Chapter 9 seeks to provide a (re)framing of socio-technical transition that is more cognisant of Global South contexts, the urban scale, the organisational level and regulatory systems.

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<sup>1</sup> This thesis applies a broad definition of values as informal forces such as social values, norms and conventions that influence public policy (Potucek and Vass, 2002)

## Chapter 2: Theorising sustainable transitions

### 2.1. Introduction

This chapter draws upon a range of concepts and theories in order to develop a theoretical framework to explore the four themes of this study: geographical context (Global South), scale (urban), regulation and organisations. Prior to exploring these themes, this chapter broadly outlines and discusses various strands of research in transitions literature in general and the MLP in particular with a focus on the theoretical underpinnings and explanatory potential of transition theories. It then seeks to construct a framework in which to explore sustainable transitions in Global South contexts (Section 2.2). This framework outlines critiques and posits alternative positions in understanding transitions and draws from theory that is more grounded in the Global South. Section 2.3 focuses on urban transitions and draws from ideas developed in, *inter alia*, multi-level climate governance, African urbanism and urban political ecology as a basis for exploring transitions in cities in the Global South. Section 2.4 provides a conceptual basis from which to explore typologies of regime transformations and pathways for change in an urban Global South context. Section 2.5 describes how regulation is understood and covered in transition theories and thereafter deliberates on conceptualisations of regulation in wider literature. Lastly, Section 2.6 develops a conceptual framework for exploring the role of organisations in sustainable transitions with particular attention paid to theory and debate on organisational structure, culture, function and organisational politics and power.

#### 2.1.1. Transitions and sustainable transitions

Technological innovations have occurred throughout human history. Fischer-Kowalski and Haberl (2007) define the history of interactions between society, technology and natural systems through three successive regimes: the hunter gatherer regime, agrarian regime and the industrial regime. These transitions occurred on epochal scales, with long-term transition dynamics. However, the pace of technological innovations increased rapidly from the industrial revolution. Perez (2002) identifies 'five transitions' from the start of the industrial era, each associated with specific technological innovations and techno-social configuration.

In both epochal (Fischer-Kowalski and Haberl, 2007) and industrial transitions the time-frames, scales and technological dominance of specific socio-technical configurations differed. The rate of change varied between rapid revolutions and more gradual evolutionary change (Sieferle, 2001; Perez, 2002). However, all major transitions were primarily driven by crises alongside 'the evolution

of new modes of existence instigated by innovation that partially or provisionally resolved the crisis' (Swilling and Anneck, 2012: 54). These sweeping historical transitions were all defined or at least influenced by a particular energy configuration (Smil, 2010). Notably, the rapid socio-technical change of the industrial revolution started a transition to a 'high energy society' that supported a surge in global economic and population growth (Smil, 1994; Mokyr, 1999). This initiated an era of intensified influence of humankind on the Earth System referred to as the Anthropocene (Steffen et al., 2007). Historical transitions, with particular reference to energy systems thus led us on a path that is the antithesis of sustainability (Crutzen, 2002).

In the past decades, a field of research has arisen that aims to understand how more sustainable socio-technical configurations may be established (Kemp et al., 1998; Schot, 1992). This field of enquiry has become known as sustainable transition theory. In particular, various frameworks have gained prominence in transition studies including; transition management (Kern and Smith, 2008; Loorbach, 2010; Rotmans et al., 2001), strategic niche management (Kemp et al., 1998; Raven and Geels, 2010; Smith, 2007), and technological innovation systems (Jacobsson and Johnson, 2000), sustainable innovation literature (Rip, 1995) and the multi-level perspective<sup>2</sup> (Geels, 2004).

Parallel to transition studies, various frameworks have emerged from within sustainability science or related fields, that seek to understand sustainable change. These include resilience theory<sup>3</sup>, studies on ecological modernisation (Sonnenfeld, 2000) sustainable or eco-innovation (Rip, 1995), industrial ecology, political ecology, urban political ecology and multi-level climate governance. This thesis engages at the nexus of these debates, but applies an STS framework, as it provides a compelling lens to investigate change of network infrastructure in cities in the Global South.

### 2.1.2. Socio-technical systems and transition theories

There are various core strands or frameworks within transitions literature. Technological innovation studies initially focused on individual innovation firms (Breschi and Malerba, 1997). The scope of analysis was widened by a number of fields to focus on sectoral systems of innovation (Dosi, 1982), technological systems (Kemp, 1997) and large technical systems (Bergek et al., 2008; Jacobsson and Johnson, 2000; Hekkert et al., 2007). The 'sectoral systems of innovation' approach broadened the scope by focusing on systems and networks of organisations. It considered institutional, historical, cultural and political factors rather than the sole focus on market forces (Fischer and Schot, 1993). Subsequently, an interest in large technical systems (LTS) emerged, with a focus on infrastructure (Coutard, 1999). In brief, LTS research analyses the ways in which system builders integrate various

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<sup>2</sup> Change in coupled socio-technical systems

<sup>3</sup> Change in coupled socio-ecological systems

components of a system, including technical, organisational and legislative elements into a functional whole as a 'seamless web' (Hughes, 1987).

Parallel to the broadening of scale of analysis, innovation studies were influenced by sustainability science with an 'explicit interest in the normative direction of innovation' (Smith et al., 2010: 437). This led specifically to fields of enquiry such as transition management (Kern and Smith, 2008; Loorbach, 2010) and strategic niche management (Kemp et al., 1998; Raven and Geels, 2010; Smith, 2007). Further, a focus on sustainability led to cross-pollination between various strands of sustainability research including ecological modernisation (Mol and Sonnenfeld, 2000), industrial ecology (Ehrenfeld, 2000) and eco-innovation (Kemp, 2010; Rennings, 2000). Moreover, there are several divergent theoretical approaches that have been adopted in the broad sustainable transitions umbrella, including a techno-economic approach, socio-ecological transitions approach, a focus on historical co-evolution of social and technological systems, active management of on-going transition processes, reflexive governance and a human geography approach (Voß and Bornemann, 2011).

More recently, the analytical perspective of innovation studies was once more expanded to consider transitions in socio-technical regimes (Geels, 2002; Geels, 2004). In this process STS theory shed some of the technological determinism prevalent in more traditional sociologies of technology. Rather, it perceived society and technology as having a recursive relationship, whereby technological systems are shaped by, and in turn shape, social processes. Many social groupings play a role in shaping a particular technological system including scientists, policy makers, activists, the private sector, engineers and users (Geels, 2005). This in turn provided the basis for the MLP, which combined an understanding of sociological processes that shape technology with the more structural notions of 'technological regimes' prevalent in evolutionary economics (Rip, 1995).

The MLP provides an analytical lens of three levels of socio-technical systems namely: landscape, regime and niche. Within this heuristic, the regime is a socio-technical system that has become stabilised into a particular configuration (Geels, 2005). Path dependency and lock-in of a socio-technical system occurs at the regime level (Geels, 2002). The landscape level is the firmly entrenched environment of a technological configuration characterised by deeply engrained political, cultural and economic structures. The landscape level is concerned with macro processes such as political climates and economic growth. Socio-technical landscapes are deeply entrenched; forming the 'physical backdrop of society' which exerts deeply structural forces that make certain technology-related decisions more difficult (Geels, 2004). Niches comprise of small, loose networks of actors experimenting with novel technologies with the goal of mainstreaming these 'niche innovations' (Rip and Kemp, 2002). Alternative sustainable technologies develop in niches. Niches

are incubated from regulatory and market forces, which enables innovation to emerge (Geels and Schot, 2007).

In terms of the MLP, transitions occur when a regime confronts systemic challenges (landscape pressures) and a niche innovation 'breaks through' and replaces the incumbent regime. Landscape pressures thus create windows of opportunity for more sustainable configurations. Smith et al. (2005) argue that regime change occurs from two processes, namely change in selection pressures and resource coordination by actors in response (adaptive response) to these pressures. The process of fostering adaptive capacity involves interactions and resource flows between actors, networks and coalitions (Smith and Stirling, 2008). For Smith et al. (2005) the manner in which selection pressures are articulated by regime members is critical to the way in which responses are coordinated. Articulation of selection pressures has two elements. It first involves the degree to which selection pressures are coherently oriented in a particular direction. Secondly, it involves processes that render pressures explicit and translated in a manner that enables a response (Smith and Grin, 2010).

### 2.1.3. Theoretical underpinnings of transition theories and the multi-level perspective

Many of the strands of transition theories draw from a diverse range of concepts, which they assimilate and adapt in novel ways. Notably, transition theories, including the MLP, integrate insights from complex systems theory, sociology of technology and evolutionary theory. For instance, the MLP is grounded in quasi-evolutionary theory, described as a crossover between evolutionary theory and constructivism (Rip and Kemp, 1998). It understands transitions as driven by changes on both the variation side and in the selection environment. Particular socio-technical systems are subjected to a multi-dimensional selection environment comprised of markets, regulation, social, cultural and political factors. Configurations 'that work' are retained and stabilised as regimes (Geels, 2005). The process of regime production and change is co-evolutionary, whereby 'regime shifts come about through interacting processes within and between landscape-regime-niche levels' (Geels, 2010: 495). This quasi-evolutionary framework resonates with Parsons' (1951) 'part and whole' or Marx's notion of 'base-superstructure' (Foster, 1999; and Jarvikoski, 1996).

Transition theories are also deeply rooted in complex systems theory. The concept of emergence is central to socio-technical systems. Complex adaptive systems develop from multiple interactions between components of a system (Holland, 1995). These interactions create emergent properties at the level of the 'whole system' (Kauffman, 1995). Socio-technical systems are similarly made up of multiple distinct elements including physical structures, natural resources, regulatory systems

and institutions (Rip and Kemp, 1998). A functional socio-technical system emerges from interactions between these elements. As with complex adaptive systems, the indivisibility in socio-technical systems relates to function rather than structure (Stirling, 2007). STS theory further lends from complex system theory in its notions of path dependency. Socio-technical regimes are defined in terms of path dependency (Rotmans et al., 2001). They build on historical social arrangements, technology choices and political decisions. Thus, socio-technical systems are preconditioned by 'dominant modes of thought' and 'criteria for performance' that were present during their initial constitution (Kemp, 1997). Over time, socio-technical systems become stabilised into a particular configuration and are reproduced through supportive rules, investment flows and political and institutional support. These locked in socio-technical systems are referred to as regimes (Geels, 2004). As a result, regimes have been described as monolithic structures that only change gradually through slight adjustments.

## 2.2. Sustainable transitions in the Global South

The preceding sections outlined the theoretical origins and underpinnings of transition theories in general and the MLP in particular. The following sections develop a framework related to the four themes of this study. This section builds a framework for analysis of Global South-based transitions, through discussing the way in which transition theories conceptualise issues of power and political economies, modernism and development, inequality and resource control.

First, it is necessary to engage with debates related to political economies and power in transitions. The current conceptualisation of sustainable transitions ignores issues of power (Lawhon and Murphy, 2011) and control over resources (Genus and Coles, 2008). Several authors have criticised transition research in general and the MLP in particular for being overly functionalist (Genus and Coles, 2008; Shove and Walker, 2007b) and for paying insufficient attention to power struggles (Smith et al., 2007; Meadowcroft, 2009) and the role of collective actors, such as classes or social movements, in transitions (Monstadt, 2009; Murphy, 2015). Castán Broto (2013) conceptualises such contradictions as drivers of change and a 'constitutive feature' of urban transitions. This uses a Hegelian notion of contradiction with regards to change. Rip and Kemp (1998) highlight that technologies can have political effects built into them. Lawhon and Murphy therefore suggest that 'transition research must do more to analyse the ways in which artefacts are embedded into society and their consequent social impacts' (Lawhon and Murphy, 2011: 360). It can be argued that conditions present in the Global South require greater scrutiny of issues of power, resource control and social impacts of reconfiguration processes. Thus, this thesis intends to explore, *inter alia* the

extent to which transitions in the Global South reproduce incumbent political economies (Myers, 2014b) and the role of collective action in regime change.

Concepts from conflict theories are important in framing this exploration. The application of ideas from conflict theory is apt for exploring socio-technical change in the Global South. Indeed, transition studies inherently integrate a range of concepts from conflict theories (Geels, 2002). For instance, STS theory assumes that incumbent regimes exert power that prevents change. Transitions thus occur 'from shifts in the balance of power' and sometimes by 'revolutions' if incumbent regimes are rapidly toppled. Transition studies share Marxian-based notions of change and an interest in exploring social systems in flux (Walby, 2008; Jarvikoski, 1996). In particular, notable transition theorists (Perez, 2002; and Fischer-Kowalski and Haberl, 2007) frame historical socio-ecological regimes in a manner that resembles dialectical materialism. The three stages of Marxian historical change, namely alienation from species-nature, the onset of modes of economic organisation, and full self-realisation may be similarly understood in terms of historical socio-ecological regimes, characterised by specific socio-technical configurations (Foster, 1999). However, whereas Marx's 'full self-realisation' refers to a socialist ideal, transition theorists regard sustainability as the desirable organising principle for socio-technical configurations. Different branches of conflict theory highlight different sources of power and social groups that exert pressure for change. Marxism focuses on power struggles between capitalists which 'control the means of production' and exploited workers (Foster, 1999). This study specifically applies concepts stemming from Hegelian Marxism (Gramsci, 1932) in exploring socio-technical regime change. According to Gramsci (1932) the 'stability of the status quo not only comes from economic domination and state coercion, but also from "hegemony", ideology and belief systems that make existing structures look 'natural' and prevent the emergence of new consciousness'. This thesis thus explores the potential for rethinking the concept of socio-technical regimes alongside Gramscian notions of hegemony.

Second, this thesis interrogates the modernist underpinnings of transition theories. STS studies tend to tacitly define sustainability as a matter of management, efficiency and technology (Shove and Walker, 2007a). This focuses on how 'innovation can redirect production towards environmental goals, and decouple economic growth from environmental degradation' (Smith et al., 2010: 435). In this framing, there is an absence of discussion on different development trajectories, different 'ways of living' and different policy contexts and technology-based templates for the future are essentially a given (Hendriks, 2008; Fischer and Schot, 1993). Sustainable transition research thus shares sensibilities with a number of ecological modernist paradigms, such as industrial ecology, eco-efficiency and the circular economy that focus on, respectively, the use

natural systems as models for industrial development (Janicke, 2008; Ehrenfeld, 2004), designing closed loop economies (Yuan and Moriguchi, 2010) or producing more goods with fewer resources (Ehrenfeld, 2005; Weizsacker et al., 1998). Thus, transitions are by and large conceptualised as a technical and productivity challenge (James, 1997; Nielsen, 2007; Ehrenfeld, 2007).

Importantly, ecological modernism conceptualises sustainability and development through the lens of the Global North and provides generic models of development for replication in the South. Transition and transition management studies are replete with notions such as policy mobility (Griffith and Dougherty, 2002), best practice (Berkhout et al., 2009) and technology transfer (Brent and Kruger, 2008) vis-à-vis north and south. Conversely, Hendriks (2009) argues that it is important to test transition theory in geographies where elite scientists and engineers play less of a role in shaping transitions. In response, this study builds on theoretical critiques of best practice and technology transfer (Kaghan and Bowker, 2001; Pieterse, 2011; Patel et al., 2015; Myers, 2011; Swilling, 2010) and develops an argument for context specific transitions along multiple development pathways.

In exploring the modernist underpinnings of transition theory, critiques from a number of authors are invaluable. Among critics, Huesmann and Huesmann (2011) argue that technologies inherently have unintended and unpredictable consequences. Accordingly, technological substitution (Berkhout et al., 2004) to improve environmental performance may in fact have the opposite effect of hastening environmental collapse<sup>4</sup>. According to Boulanger (2010), transitions based on environmental efficiency are grounded in four assumptions, each of which is open to criticism. These are confidence in technological innovation as the main solution to sustainable development; reliance on the private sector as the principal driver of transformation; faith in markets and capitalism; and underlying trust in economic growth. In response, this thesis seeks to explore transitions through the lens of the state, public goods and socio-economic criteria that are broader than both environmental performance and market growth.

Third, related to the above, this thesis builds on critiques of Global North sustainability governance and policy in relation to its neo-classical economic leanings. Sustainability science and governance often perpetuates a focus on 'rational resource allocation decisions under condition of scarcity' (Geels, 2010: 497). In this paradigm, the aggregation of rational choices, regulated by price signals and the market, create macro-economic order. Transitions are thus viewed through the lens of market failures related to environmental externalities within incumbent regimes. As such, sustainable transitions are achieved by changing the conditions under which markets operate

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<sup>4</sup> or result in rebound effects



(Hanley et al., 2009). This shares similar themes with environmental economics, which explains the degradation of coupled natural and social systems through the lens of market failures, such as externalities (Runnals, 2011) and 'common property resource' challenges (Hoffmann, 2011). Several criticisms may be levelled at this neo-classical economic underpinning of sustainability governance and policy. First, it tends to assume that sustainable change is not only compatible with market-led growth, but in fact a potential driver of growth (Lander, 2011). In contrast, several authors argue that market forces have created unsustainable societies and hence cannot be relied on to re-orient our social, ecological and technical systems (Spash, 2011). Sanzana Calvet and Castán Broto (2015: 12), for instance, argue that, rather than providing windows of opportunities for change, infrastructure shocks and disruption may in fact be conceptualised as a neoliberal mechanism for regime reproduction and 'stabilisation under a neoliberal hegemony'. Further, it is arguable that the neo-liberal economic tendencies in sustainability policy and practice is reductionist and diverts from a full understanding of the drivers of complex problems (Hoffmann, 2011). Related, sustainable transition studies pay limited attention to transitions in different political economies such as development states (Swilling and Annecke, 2012).

Four, this study critiques the framing of 'sustainability' in sustainable transition studies. Current transition research tends to narrowly focus on whether a particular socio-technical system is 'inherently bad or good' based almost exclusively on environmental performance and at best pay lip-service to social sustainability (Ehrenfeld, 2007). In response, this study explores the underlying social conditions and social sustainability of reconfiguration processes. In this task, integrated conceptions of sustainability are drawn from, that are cognisant of issues of justice, poverty and politics. Agyeman et al. (2003) argue that sustainability, in theory and practice, is dominated by environmental concerns. This leads to an 'equity deficit', where social needs, welfare and livelihoods are not properly considered (Dobson, 1999). In response, the idea of 'just sustainabilities' incorporates indicators such as well-being, justice and equity in the procedures and outcomes of sustainable change (Agyeman et al., 2002). Similarly, the concept of 'just transitions' developed by Swilling and Annecke (2012) pays greater attention to social transformation processes and bottom-up empowerment. The notion of 'just transitions' explores potentials for dissecting and reassembling the 'flows and networks of a city' (Swilling and De Wit, 2010). Importantly, it overlays ecological concerns and analysis of urban infrastructure networks with developmental thinking and explores transitions from the position of a developmental state (Swilling and Annecke, 2012). These offer a more nuanced, context-specific framing of sustainability than transitions studies and provide a lens to examine the 'social' elements of sustainability.

Due to the critiques and gaps in sustainability science and transition theories discussed above, it is necessary to outline theory that is more cognisant of Global South contexts. De-growth stands in direct contrast to the neoliberal underpinnings of sustainable transition studies. It argues that consumption lies at the heart of social inequality and environmental degradation. Thus, contraction of our economies alongside different systems of valuation should be central to transitions (Fournier, 2008). De-growth responds to unsustainable systems through downscaling (Demaria et al., 2013) rather than changing techno-economic configurations. Notably de-growth argues for abandonment of market-led growth as a means to end exploitation in the Global South. Social ecology adopts a similar position. Social ecologists argue that capital expansion is the root of poverty, social exclusion and environmental degradation. Accordingly, they argue for the dismantling of capitalism and the promotion of common ownership of the means of production (Gare, 2000). Social-ecology paradigms are commonly used to examine environmental crises in the Global South, social justice and 'environmentalism of the poor' (Foster and Holleman, 2012). Critiques of Global North sustainable transition frameworks from a social ecology perspective may include inadequate consideration of social transformation; ignoring the impacts of capital expansion on local production and self-sufficiency; and avoidance of issues of 'class, gender or any other category of domination' (Foster, 1999).

Political ecology (PE) is an important counter framework for examining sustainable change. PE has its roots in Marxian political economy (Watts and Peet, 2004) in contrast to the neo-classical economics of the MLP (Geels, 2004). Importantly, it critiques modernist sustainability discourses, has a strong tradition in Africa (Myers, 2014b) and a focus on inequality and power. This makes it a relevant counter theory to understand socio-technical systems in the Global South, particularly related to energy poverty and the structures that reproduce it. PE focuses on the ways that environmental and social change 'co-determine' each other. In processes of change, both physical and social systems are transformed into novel configurations (Bryant and Bailey, 1997). These socio-physical environments are a result of particular historical, social, cultural and economic conditions. Changes in social conditions are always accompanied by changes in environmental factors (Escobar, 1998) which are never neutral in terms of impact. According to Swyngedouw:

Conditions under which particular trajectories of socio-environmental change undermine the stability of some social groups or places, while the sustainability of social groups and places elsewhere might be enhanced. In sum, the political-ecological examination reveals the inherently contradictory nature of the process of socio-environmental change and teases out the inevitable conflicts (Swyngedouw, 2006: 115)

In processes of change, actors with power dictate access to and control over resources and, in the process, exclude others. As a result, political ecologists pay more attention to social power relations

in resource and infrastructure governance. Sustainability thus becomes a political question that examines who benefits and suffers from particular processes of change. Through a PE lens, sustainability is achieved by democratic processes of 'socio-environmental (re)construction' that result in equitable and inclusive distribution of social power (Swyngedouw et al., 2002:4). Despite these differences both political ecology and the MLP share a structuralist bent. PE applies a neo-Marxian structuralist frame to understand the reproduction of poverty and inequality, whilst the MLP focuses on the reproduction of dominant socio-technical regimes.

As with PE, environmental (Myers, 2008), climate (Page, 2007) and energy justice (Goldthau and Sovacool, 2012) frameworks stand in opposition to transition theories in understanding sustainable change. Schlosberg (2007: 56) defines environmental justice as 'equitable distribution of environmental risks and benefits and fair and meaningful participation in environmental decision-making'. A central concept of environmental justice absent in transitions literature is environmental discrimination against marginalised groups (Patel, 2014; Barrett, 2013; Dobson, 1999). This manifests in a socially dominant group gaining privilege and the concomitant mistreatment of non-dominant groups in environmental policy and action (Schlosberg, 2007). Environmental elitism and discrimination manifests in three different forms. First, environmentalists are usually middle or upper class (compositional). Second, environmental reforms benefit ideological supporters but impose costs on non-participants (ideological). Third, environmental reforms have 'regressive social impacts' in that they disproportionately harm marginalised groups (Schlosberg, 2007; Morrison, 1986). This thesis seeks to balance transition theories with certain environmental justice themes. There is value in using an environmental justice lens when examining regimes and reconfigurations in the Global South, where there is widespread poverty and marginalisation in relation to infrastructure. In particular, this study explores the extent to which sustainable reconfiguration processes may benefit 'environmental elites' at the expense of marginalised groups.

### 2.3. Scale and urban transitions

Several authors argue that the MLP requires greater consideration of scale (Coenen and Truffer, 2012; Murphy, 2015; Coenen and Hansen, 2015.).<sup>5</sup> The lack of consideration of scale prevents a proper understanding of why transitions and progress towards transitions are spatially patchy and uneven (Coenen and Truffer, 2012) and creates uncertainty as to where transitions occur. In response, there has been increasing diffusion of geographical concepts in transition studies

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<sup>5</sup> It is important to note that the analytical levels of the MLP are not geographical scales at all but rather a measurement of the pervasiveness of a socio-technical system within a 'common context' (Coenen et al. 2012).

(Murphy, 2015; Lawhon and Murphy, 2012; Coenen et al., 2012). This cross-pollination enables the exploration of the role of geographical context (Murphy, 2015) and multi-scalar factors in shaping transition processes. Notably, Murphy (2015) offers a framework to examine socio-spatial contexts and geographically specific features that enable or constrain alignments between niches, regimes and landscapes.

Simultaneously, there is an increasing interest by geographers in the urban dimensions of transitions (Murphy, 2015). Späth and Rohrer (2012) argue that the absence of application of transition studies to urban contexts is problematic because of the prominent role cities are playing in sustainable transitions. Smith (2007a) holds that cities are hubs of innovation and the sites in which technologies are embedded. According to Truffer et al. (2008) urban policy networks mobilise significant resources to either stabilise or influence regime change. Accordingly, analysis of the city-scale is necessary for a full understanding of transitions. Several authors investigate sustainable urban infrastructure reconfigurations including Simon (2016), Monstadt (2007), Graham and Marvin (2001), Hodson and Marvin (2009a; 2009b) and Bulkeley and Betsill (2003). Hodson and Marvin (2010) record cases of cities that are actively engaged in reconfiguring infrastructure through interactions that cut across scales. In their study they map urban responses to pressures, identify transition processes and speculate on the consequences of city-scale transitions. Notably, there are several debated questions on the relationship between cities and the MLP. Truffer et al. (2008) question whether cities sit outside the MLP or whether they traverse the niche-regime-landscape framework. Hodson and Marvin (2009a) question whether cities are merely receivers of transitions or actively shape transitions; and whether cities are merely 'convenient sites in which niches' develop (ibid: 518) or are involved in creating selection pressures.

In linking the urban and Global South themes of this study, Hodson and Marvin (2010) argue that transition studies have been limited to 'premium world cities' and should examine cities with limited resources and cities in the Global South. This echoes critiques by Robinson (2006) and Myers (2008) on the relevance and applicability of urban theory embedded in a specific geography and associated 'ideological economic' leaning to African or Global South cities. Myers (2014a: 104) highlights that comparative frameworks in urban studies are limited in the cities they explore and the prevailing focus on global cities creates an assumption that these cities 'speak to the concerns of cities everywhere'.

In response to the above, this study seeks to contribute to several sub-themes related to scale in general, and urban transitions in the Global South in particular. First, this study explores interactions between urban policy networks, traditional state hierarchies and the niche-regime-

landscape framework. In this investigation, it applies concepts from multi-level climate governance (MLCG) to examine the ways in which urban actors shape, constrain and develop policy related to regime reconfigurations. The application of multi-level climate governance within a sustainable transitions, and MLP framework specifically, is fitting, as they share certain sensibilities. Both explore vast processes that are wider than the state and focus on nested interactions. Yet, multi-level climate governance pays greater attention to analysing and mapping networks or urban actors (Bulkeley and Betsill, 2003; Bulkeley and Betsill, 2005). In particular, governance typologies developed in MLCG may be useful for exploring the ways in which urban actors influence regime reconfigurations. Castán Broto (2017) highlights the context specific manifestations of urban climate governance, the increasing influence of urban network governance modalities in international climate policy and the increasing role of experimentation in discourse and governance of cities. Bulkeley and Betsill (2005) classify modes of urban governance according to enabling (supporting), authority (establishing rules), self-governing (municipal operations) and provision of services. Bulkeley and Kern (2006) identify governance by negotiation, governance by hierarchy and governance by facilitation. Research by Hooghe and Marks (2003) is also useful in this regard. They distinguish between two typologies of urban climate governance. 'Type I' describes the strict hierarchy of government administrative units (national, provincial and local) and ways in which infrastructure and climate responses are nested within these hierarchies. This type of governance is characterised by strict and clearly defined hierarchy and mandates. 'Type II' is a form of governance undertaken by dynamic networks of actors that include private, public, not-for-profit and communities. These networks do not operate within strict hierarchies and engage in resource sharing in order to 'fill the void' of ineffective state responses (Alber and Kern, 2008; Allman et al., 2004; Lindseth, 2004; Bebbington, 2003).

Second, this study explores tensions between nationally bounded regimes and urban transitions. Several authors highlight the growing ambition amongst cities to secure and control urban resources and reconfigure their urban infrastructure (Hodson and Marvin, 2009a; Bulkeley and Betsill, 2005). Späth and Rohrer (2012: 475) hold that due to the availability of resource capabilities, infrastructure systems in cities 'can deviate quite substantially from dominant regime characteristics'<sup>6</sup>. Rohrer and Späth (2009) further highlight that cities provide social groupings with the potential to shape socio-technical reconfigurations that differ from national regimes. Hodson and Marvin (2009a) illustrate that concerns over urban ecological security (UES) in global cities increasingly informs policy to reconfigure urban infrastructure. However, these strategies

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<sup>6</sup> This similarly highlights that urban transitions may differ substantially from regional and national infrastructure transitions

tend to 'selectively privilege particular urban areas and social interests' (ibid: 193). This study seeks to contribute to these debates, by exploring the manifestations of urban ecological security in a highly unequal African city and examining the extent to which urban ecological securitisation impacts on national transition agendas in a developmental state. This requires examination of bounded and contested securities and the manner in which geographically-based transitions exclude other regions.

Third, this study seeks to identify unique conditions and 'specificities' (Silver and Marvin, 2016) of infrastructure networks in an African city, in order to gauge insights that this may offer transition theories. According to Silver and Marvin (2016), a Global South focus highlights the presence of contestation in socio-technical transitions and visions. In general, urban transition studies assume that political tensions can be resolved through rational, consensus-based decision-making (Smith and Stirling, 2007b, Parnell and Pieterse, 2014; Myers, 2011). This pays insufficient attention to the existence of 'irreconcilable interests', contested politics (Silver and Marvin, 2016) or the role of 'institutional and grassroots politics' (Pieterse, 2012) in transforming cities towards more sustainable configurations (Swilling, 2010). Notably, STS research seldom focuses on the realities of vested interests (Murphy, 2015), differential power (Lawhon and Murphy, 2011), 'asymmetrical power' (Pieterse, 2014) and the role of democratic processes in rebalancing power dynamics within socio-technical transitions.

Four, this study explores the links between cities, development trajectories and socio-technical regimes. It is evident that urban studies embedded in Global South contexts pay greater attention to the nexus between development and environmental sustainability. Bulkeley et al. (2014), for example, using case studies in Cape Town and Sao Paolo, conceptually frame social housing as network infrastructure that is being reconfigured by local government. The provision of energy services and improving the efficiency of these services in social housing highlights a union of development challenges and global urban climate change governance. Accordingly, it is argued that 'the governing of climate change in cities in the Global South is multiple, combining market and social logics in eclectic ways, and both are in constant negotiation, dialogue and contestation' (Bulkeley et al., 2014: 21). Related, transition studies are underpinned by neo-liberal economics as a means of achieving socio-technical change<sup>7</sup>. This orientation is mirrored in urban transition studies (Lawhon and Murphy, 2011) where urban economic growth and increased resource use are regarded as non-negotiables. This reinforces the assumptions in development economics that urban development follows a definitive trajectory from underdevelopment to full development and

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<sup>7</sup> See Section 2.2

fails to appreciate constraints within urban contexts in the Global South. Conversely, approaches in southern urbanism are cognisant of the dependence of urban economies and infrastructure systems on regional and natural environments (Pieterse, 2011) and valuing sustainable urban lives and livelihoods as transition indicators (Myers, 2008; Patel, 2014). This signals the conceptual value of a developmental lens for exploring urban sustainable transitions in the Global South.

Finally, this study explores tensions between public goods and privatisation in relation to socio-technical regimes and the interconnected 'equity deficit' of urban transitions. Monstadt (2009) highlights the widespread and interwoven restructuring of both network infrastructure and cities in the past two decades. Although utility and urban restructuring has been concentrated in the industrialised world, network infrastructure in the Global South has likewise been rapidly privatised and corporatised in replicating northern infrastructure reform (Eberhard, 2005; Politt, 2007; Parnell and Pieterse, 2014). Notably, utility restructuring is accompanied by service unbundling, where customers that can afford it are provided access to optimal levels of service (Satterthwaite, 2007). Savage and Ward (2003) refer to the presence of differentiated infrastructure provision between the rich and poor as 'infrastructure consumerism'. The main drivers of this restructuring include increasing power of transnational companies; changes to social welfare delivery; and sweeping liberalisation, privatisation and deregulation of public services (Monstadt, 2009). This has resulted in the radical socio-spatial reorganisation of cities and the deterioration of the state's role in producing common goods.

Such restructuring is made possible by the 'political clout' wielded by elites (Satterthwaite, 2007; Monstadt, 2009; Myers, 2008). This has particular manifestations in the Global South, whereby municipal governments, eager to attract foreign investment, focus on the provision of highly modern infrastructure aimed at linking 'wealthy parts of cities to the global economy' at the expense of resource allocations to the poor. Huchzermeyer (2011) argues that this 'competitive cities agenda' results in at best neglect and resource diversion from pro-poor urban agendas and at worst, attempts to 'aggressively eradicate' symptoms of poverty.

These trends have intersected with technological innovations, sustainable change and electricity systems in complex ways. For instance, trends in privatisation, service unbundling, decentralisation of services and increased user choice as a result of affordable distributed technology has created conditions for the wealthy to 'opt out' of network infrastructure. Avrabos (2014) describes this trend as a self-reinforcing crisis known as utility death spirals.

A kind of "death spiral" or "vicious cycle" has been created. As customers leave the utility service and provide their own power, the departing customers' share of utility costs fall

on fewer customers. This raises utility rates causing more customers to leave the grid (Avrabos, 2014:27).<sup>8</sup>

According to Monstadt (2009) the urban dimension of infrastructure restructuring and associated implications for urban sustainability has not been sufficiently theorised or empirically tested. Nevertheless, an increasing body of research examines the extent to which infrastructure reform aggravates urban inequalities or ‘splintering urbanism’ (Monstadt, 2009; Jaglin, 2008; Graham and Marvin, 2001) where the wealthy have ‘modern, connected and smart’ urban goods and services with limited or no access provided to the poor (Graham and Marvin, 2001; Jaglin, 2008).

There is further a considerable body of research related to urban electricity and other infrastructure systems, which are explored within questions of neoliberal policy and privatization. McDonald (2008) in particular provides a historical overview of institutional and structural reform in Cape Town as a result of neoliberal policies and associated political marginalisation, (de)racialization, privatisation. In doing so, it provides a critique of the world city narrative from the perspective of a city in the Global South. Other notable contributions that examine urban infrastructure systems in African cities, through the lens of privatisation and neoliberalism include McDonald and Ruiters (2006), Ghanadan (2009), Baptista (2013; 2018) and Simone (2001).

The above concepts and ideas, *inter alia*, splintering urbanism; infrastructure differentiation; service unbundling; and erosion of public goods are important for examining urban transitions in the Global South. Specifically, this study examines the extent to which regime reconfigurations create infrastructural enclaves such as gated communities (Jaglin, 2008; Graham and Marvin, 2001); the implications of interwoven privatisation, unbundling, deregulation and technical innovation on aggravating inequality; and the changing role of the state in the provision of public good and cross-subsidisation.

There are a number of concepts developed by southern and African urbanism scholars that may inform an urban transition framework more sensitive to Global South conditions. These require brief discussion. In response to the limitations of conventional sustainability frameworks, southern scholars have aimed to frame urban sustainability debates in light of the ‘emerging dynamics’ of rapidly urbanising cities in the Global South (Pieterse, 2011) and in consideration of justice (Swilling and Anneck, 2012) and inequality (Lawhon and Murphy, 2011). Southern urban scholars adopt a more process-oriented approach to sustainability, which frames it as an iterative and on-going process (Patel, 2014). These sustainability frameworks consider diversity in development pathways rather than prescribing a model of ‘global homogeneity’ (Satterthwaite, 2007; Huchzermeyer,

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<sup>8</sup> The implications of death spirals on socio-technical networks in the Global South have not been adequately examined.



2011). They further provide room for greater consideration of locally relevant agendas, priorities and solutions (Roberts, 2014; Robinson, 2002; Pieterse, 2011) and are cognisant of the impact of global and national politics on local conditions and accompanying limitations on autonomy of local actors (Huchzermeyer, 2011).

Radical incrementalism, for instance, stands in opposition to the 'the totalizing logic of top down planning' (Lawhon et al., 2013:24) and rather explores possibilities of stabilising actor-networks that offer alternative transition visions. It envisages a gradual and bottom-up approach to transition processes in order to develop infrastructure systems based on entirely different values and belief systems. Pieterse (2011) advances an 'alternative urban development framework' to inform sustainable pathways for cities in the Global South. An alternative urban development framework advocates for processes of change that are similarly sensitive to grass-roots politics, visioning that is 'grounded' in realities of the urban poor and based on participatory engagement, particularly through social movements. Pieterse (2011) understands cities as a functional system comprised of three major operating systems; infrastructural, economic and spatial. Sustainability requires the transformation of these three co-constituted operating systems. These systems are transformed through processes of grounded alternative visions and effective politics. Yet, the form and transformation of these operating systems depends 'on how power is distributed in society and mediated in local political institutions' (ibid: 314).

Urban political ecology (UPE) too offers different insights. UPE combines a focus on networked infrastructure, neo-liberal critiques, Marxian class analysis and post-structuralism (Myers, 2014b). UPE understands cities as being created by historical processes of capital accumulation (Monstadt, 2009). These historical processes differ significantly in Global North and South contexts. For example, in the Global North, centralised electricity infrastructure was developed partly as a means for ensuring 'universal access to services'. Conversely, Lawhon and Murphy (2011: 475) argue that in African cities this modernist ideal 'is little more than a chimera' which 'has never constituted the majority experience'. Lawhon et al. (2014) argue that urban sustainable transitions are increasingly focused on 'managerial, technocratic and apolitical approaches'. Conversely, UPE examines urban transitions through the lens of inequality, justice and poverty and offers a critique on modernity and capital accumulation. A central focus of UPE concerns interactions between urban processes, urban resource flows and their environmental impact. Notably, UPE provides a useful framework for examining networked infrastructures as socio-ecological systems (Monstadt, 2009). This requires exploring the relationship between network infrastructure, material flows, distributional justice and contestation over resources within cities (Lawhon et al., 2014; Swilling and Annecke, 2012).

Finally, it is evident that many of the themes of this thesis mirror wider and older debates in urban geography and urban studies, related to, *inter alia*, relative autonomy of the local state, decentralisation (Seabright, 1996), urban regimes (Jessop, 1997), urban political economy (Molotch, 1976) and the transformation of regimes of regulation (Lipietz, 1992). In turn, many of these themes have been incorporated into urban transition studies.

#### 2.4. Transition pathways and typologies in cities in the Global South

The above themes of scale and geographical context (Global South) have a direct bearing on the conditions, pathways and governance of regime reconfigurations. This section seeks to provide a framework in which to explore pathways and typologies for transitions in cities in the Global South.

First, this study seeks to explore pathways of change in a developmental, contested context. In this regard, ideas stemming from sociology of technology may potentially inform a sustainable transition framework that is more oriented to the Global South. Griffith and Dougherty (2002: 209) argue that socio-technical studies can go ‘further beyond technological determinism’ particularly through conceptualising technological systems as social constructs, exploring perceptions of technology, and examining the organisational structures of technology systems. Genus and Coles (2008) advocate for the complementarity of systems in transition literature with the constructionist approach of social construction of technology (SCOT). SCOT highlights the ‘open-ended character of technology development’ (Genus and Coles, 2008: 1443) and thus enables an evaluation of multiple potential paths of socio-technical transitions. This lens is particularly valuable to Global South contexts, where infrastructure systems may not be as fixed or matured. Thus, a framework for theorising on multiple development or transition pathways is an important approach to counter the modernist underpinning of sustainability science and governance. Constructive technology assessment (CTA), similarly, is a constructivist approach to understanding the interrelationship between technology and society. It highlights the potential for alternative technology choices and is sensitive to social inclusiveness in navigating the direction and outcomes of socio-technical change (Bijker, 1995). CTA engages with the ways in which discourse and policy on technology, in relation to its use, access and social impact exclude certain social groups (Sayer, 2008). It thus stands in contrast to the notion of a ‘transition arena’ in transition management.

Kaghan and Bowker (2001) further argue for linkages between socio-technical transitions and actor network theory (ANT). ANT concerns technological change on the micro-level and highlights the ‘steps from the birth of an idea to its commercialisation’ (Callon, 1987: 83). ANT focuses on the links between human, non-human and ‘hybrid’ human/non-human actors in a network (Johnson, 1988) and seeks to overcome the dualism between the social and natural world (Freudenburg, et al.,

1995; Rice, 2013; Pickering, 1995). ANT provides a powerful framework to evaluate the gradual progression of new technologies and socio-technical configurations in a dynamic way. Unlike the MLP, it offers a lens to evaluate the processes of 'negotiation and enrolment that actors engage in' with regards to socio-technical development and change (Genus and Coles, 2008: 1443).

The use of a more constructivist lens is particularly relevant in Global South contexts where infrastructure trajectories are less pre-determined by past decisions or modes of thought. It is arguable that the Global South provides wider scope for an investigation of 'potentialities' in socio-technical trajectories in general and greater discourse on use, access, applicability and social impact in particular. Further, the assimilation of constructivist approaches to technology could arguably circumvent several pitfalls in sustainable transition theory. It would place greater emphasis on interactions between actors that shape (elites) and those actors that affected by (the urban poor in this case) technology development (Kaghan and Bowker, 2001). It would be more attuned to the 'specifics of development' in particular cases and render the political processes involved in the relationship between 'technology and society' more visible (Rice, 2013). It would highlight 'the interpretability and stabilisation of beliefs about benefits, risks and uncertainties associated with processes of socio-technical change' (Genus and Coles, 2008: 1443). Finally, it would enable an analysis of a variety of possible transition paths or alternative development possibilities in specific contexts in contrast to the deterministic approach found in ecological modernism.

Authors have offered a number of proposals for broadening sustainable transition theory with parallel fields in technology and society. These include a more systematic analysis of the complex factors that enable or constrain transformations (Russell and Williams, 2002); consideration of the contribution and interaction of diverse groups to transitions (Lawhon and Murphy, 20013); the extent to which state organisations affect the diffusion of technology through society (Scrase and Smith, 2009); an analysis of the behaviour and assumptions of various protagonists in technology development (Kaghan and Bowker, 2001); identification of interactions regarded as facilitative or obstructive to transitions (Shove and Walker, 2010); and analysis of ways in which actors construct conducive or inhibiting factors and the ways in which they construct other actors (Genus and Coles, 2010). These proposals are invaluable for the purposes of this study, which seeks to analyse the ways in which actors interpret and negotiate regime rules; identify urban policy networks and the ways in which they facilitate or obstruct transitions; evaluate the ways in which organisational actors constrain or support regime change; and the role of the state (the City of Cape Town) in regime transformation.

Second, this study engages with reconfiguration processes and dynamics from the perspective of a city in the Global South. It has been highlighted<sup>9</sup> that the MLP is significantly influenced by dynamic systems theory (Breschi and Malerba, 1997) in the use of concepts such as emergence, path dependency and indivisibility of regime elements. However, a significant divergence between dynamic systems theory and the MLP relates to conceptualisation of equilibrium. Essentially, complexity theory overturned the notion that systems tend toward equilibrium or stable states. Parsons (1951) argued that change is caused by external disturbances which 'disrupt equilibrium'. Conversely, the MLP views socio-technical systems 'as punctuated equilibria, shifts from one stable state to another' (Geels, 2010: 501) and pays less attention to non-linear change (Kauffman, 1995). The existence of positive feedback loops is a critical element of rapid change (Capra, 1982). A positive feedback is a process whereby a mechanism in a system responds to change in a manner that escalates the change, driving a system further away from equilibrium. Incremental change can accordingly result in abrupt change (Arthur, 1994). Nevertheless, positive feedbacks are not sufficiently incorporated into reconfiguration typologies in the MLP.

In understanding dynamic change in regimes there are also learnings that may be gained from resilience theory. Sustainable transitions and resilience share many similarities (Smith and Stirling, 2008; Foxon et al., 2009). A brief comparative of these two frameworks is thus useful for understanding drawbacks in the MLP related to exploring dynamic change. Both theorise about coupled and complex systems. Whereas resilience concerns coupled socio-ecological systems (Adger, 2000) sustainable transitions explores coupled socio-technical systems. In both cases, these systems are co-evolutionary and display dynamic and emergent behaviour (Carpenter and Gunderson, 2001). In both, exogenous pressures or disturbances drive change (Walker et al., 2004). Specifically, reconfiguration typologies developed by Berkhout et al. (2004) and Geels and Schot (2007) share many features with the adaptive cycle, which offers a similar explanation of system dynamics. However, resilience and the MLP have significant differences. Resilience stands in opposition to efficiency arguments inherent in the MLP, whereby an efficiency approach to sustainability often acts counter to the goals of sustainability (Gunderson, 2000). Managing a system for optimisation may work in the short-term, but in the long-term this creates a host of challenges by removing redundancies and response diversity (Elmqvist et al., 2003). Transition studies pay little attention to the function of redundancies and diversity in a system. Rather, sustainable reconfigurations would tend to retain the rigidity of old incumbent regimes. Transition management, accordingly, could be regarded as a mode of responding to pressures that created these pressures in the first place, i.e. by seeking increased optimisation and control.

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<sup>9</sup> See Section 2.1.3

Importantly, resilience pays greater attention to positive feedbacks, thresholds and tipping points. It holds that socio-ecological systems can exist in multiple domains. A series of shocks to a system can push it across thresholds into a different stable state with completely different structures and functions. Once a system has crossed thresholds it is exceedingly difficult to return to a past stable state (Folke et al., 2004).

The absence of attention to positive feedbacks, tipping points and cascades in transition studies is a conceptual gap that should be reflected upon. Notably, this study examines the conditions under which regimes can become rapidly unravelled and the associated social, political and economic ramifications of socio-technical systems in disequilibrium domains. This is particularly relevant to the Global South where the social features and elements of socio-technical regimes are arguably less stable and under considerable pressure.

Third, this study seeks to reflect on the applicability of existing transition typologies for cities in the Global South. Sustainable transition scholars have aimed to categorise the ways in which regimes change. Berkhout et al. (2004) describe four transition typologies. 'Endogenous renewal' involves an incremental transition whereby stakeholders within a regime, using available resources, coordinate a transition in a coherent manner. 'Re-orientation' occurs when stakeholders within a regime, in response to pressures, seek to adapt and re-orient the regime using resources available. 'Emergent transformation' occurs from activities of external stakeholders that innovate and generate technologies in an uncoordinated way. These innovations place external pressures on the regime. Finally, 'purposive transitions' are deliberate processes that seek to 'translate shared visions into articulated pressures to change and to mould responses to the need for change' (Genus and Coles, 2008: 1439).

Geels and Schot (2007) outline four types of transition pathways, namely: transformation, technological substitution, reconfiguration, and de-alignment-re-alignment. These are defined by their timing and nature of multi-level interactions. 'Transformation' occurs when there is moderate external pressure at a point in time where niche innovations are under-developed and unable to break through. However, these moderate pressures may cause regime actors to question elements of the regime and hence modify the trajectory of the regime (Geels and Schot, 2007: 13). 'De-alignment and re-alignment' ensues when a landscape pressure repeatedly impacts negatively on a regime, causing regime members to lose faith in the regime. This process is termed de-alignment. A regime collapses from a combination of internal problems and landscape pressures and regime members fail to defend the status quo causing a 'hollowing out' of the regime (Geels and Schot, 2007: 15). If a niche innovation hasn't developed as a viable alternative to the regime, space is opened up for multiple innovations to compete until a particular one dominates. 'Technological

substitution' happens when a large landscape pressure occurs at a point in time where niche innovations are sufficiently matured to replace the regime but are unable to break through due to the relative stability of the regime. Rather, minor innovations are incorporated into the regime causing incremental adjustments. Innovations then gradually replace old technologies, which eventually lead to change in the incumbent regime. Finally, 'reconfigurations' occur when niche innovations are adopted by regime members to solve local problems resulting in the emergence of a new configuration.

These provide interesting heuristics for classifying and analysing pathways of change. However, the above classifications of regime transformations do not coherently theorise on the socio-economic dynamics or outcomes of regime transformation. It is thus of theoretical interest to explore and potentially expand these classifications to Global South contexts. In developing these typologies, lessons may be drawn from concepts such as: splintered urbanism (Graham and Marvin, 2001; Jaglin, 2013) and differentiated infrastructure provision (Savage and Ward, 2003); themes of hegemony central to Hegelian Marxism (Foster, 1999); and collapse and reorganisation in Schumpeter's (1939) notion of 'waves of creative destruction'. Notably, Castán Broto et al. (2014) argue that infrastructure shocks may both catalyse and enable learning related to system change and strategic infrastructure visions. These may be useful in conceptualising the impacts of sudden regime reconfigurations (rupture) in enhancing conditions where the wealthy have access to modern infrastructure services at the expense of the poor (splintered urbanism) and infrastructure provision and quality that is differentiated according to wealth (differentiated infrastructure).

## 2.5. Regulation and regimes

Genus and Coles (2008) argue that the MLP pays insufficient attention to the relationship between rule systems and regime reproduction or reconfigurations. In response, this study engages with the extent to which top-down, formal rules structure regime stability and change. It is thus necessary to outline the manner in which this is currently conceptualised in transition theories. Grin (2012) holds that rule systems that govern regimes and niches differ. Rules that regulate regimes tend to be stable whereas niche rules are more fluid. Smith (2010) holds that regime rules provide stability by guiding perceptions and actions. Geels (2007) using Scott's (1995) classification outlines three types of rules of importance for niches and regimes: regulative, normative and cognitive rules. Regulative rules are formal rules established by government aimed at regulating behaviour. Normative rules relate to relationship roles, values and behavioural norms, whereas cognitive rules are forged through belief systems, agendas and guiding principles (Rice, 2013; Parsons, 1937). Although this study mainly focuses on regulative (formal) rules, it also interrogates the interactions

between regulative and normative rules in enabling or constraining transitions with a specific focus on the normative values that underpin formal rules.

Second, this study seeks to explore regulatory coherence with specific attention to the temporal dimensions of regulatory coherence of regime rules in urban transitions. According to MLP scholars, rules do not exist as single autonomous entities but are rather organised in rule systems. As summarised by Geels:

Regimes are semi-coherent sets of rules, which are linked together. It is difficult to change one rule, without altering others. The alignment between rules gives a regime stability, and “strength” to coordinate activities (Geels, 2005: 450).

However, the processes by which rule systems are linked and potential disjunctures in this alignment are less clear. Rip and Kemp (1998) describe the ways in which legal instruments or artefacts reproduce regimes and establish the importance of rules in regime dynamics. However, in general transition theories do not adequately investigate the alignment of rules and other regime subsystems. There is an increasing body of research that explores coherence and alignment at the intersection between regulation, technology and innovation that is useful in this regard. Dewick and Miozzo (2002), in exploring rules related to sustainable infrastructure, highlight that innovation seeks to shift the status quo and replace rules and processes of regulation. Inversely, regulation can stimulate innovation through a range of mechanisms and in certain circumstances standardise and mainstream innovation (ibid). The relationship between regulation and innovation has been explored in several relevant disciplines including urban transitions, research on infrastructure reform, energy and electricity reconfigurations and strategic niche management. Importantly, Ford (2013) critiques two common assumptions in the relationship between rules and technological innovation, namely: the notion that private sector innovation is always beneficial and the belief that regulation sits outside innovation. Of relevance, innovation framing regulation argues that ‘extensive, rapid and technically complex innovation is inevitable’ and public regulators thus struggle to keep abreast with innovation (ibid: 77). Innovation-framing regulation thus pays attention to the capacity of regulation to both cope with and manage change. In brief, it is concerned with the ability to respond and adapt to constant exogenous change. Such a conception is well suited to the MLP particularly in relation to landscape pressures. In Ford’s words:

Innovation-framing regulation considers the nature of regulation, in fields where it has had to respond and adapt to subject matter that is being transformed, radically and continually, by private sector innovation (Ford, 2017: 77).

Third, this study engages with interactions between national and urban transitions in relation to regulation. This is particularly relevant for linking the themes of scale and regulation of this study. Alber and Kern (2008) argue that the success of urban energy transitions depends largely on the

authority of local governments to formulate and implement electricity regulation. Schreurs (2008) contends that where local governments are unable to establish energy policy, taxes and standards, their scope of influence is limited. The importance of regulatory autonomy among various tiers of government has been highlighted by several urban transition scholars (Hodson and Marvin, 2010; Bulkeley et al., 2003). This is because regulation tends to structure political and economic processes at the national level (Geels, 2007). Smith (2007a) argues that in many jurisdictions, municipalities have successfully lobbied for increased autonomy and decentralisation of powers related to energy infrastructure. Thus, mandates and regulatory autonomy and contestation over such authority are important issues for investigation.

Four, this thesis engages with debate, amongst transition authors, on the extent of agency in the creation and reproduction of rules. According to Geels (2004) regimes are underpinned by a coherent set of rules that provides stability to the regime. As a result of these rules, socio-technical regimes are largely impenetrable to change. Geels and Schot (2007: 415) conceptualise 'multi-paradigm' agency that operates within a 'rule-based model of action'. This conception provides for only a degree of strategic intervention but nonetheless tends towards a more structuralist paradigm whereby actions of actors are bound by rules. In contrast, Kemp and Loorbach (2006) submit that rule systems are more fluid and are constantly adapted in practice. Rip and Kemp (1998) argue that rules are given form and change through processes of negotiation between social groups. Regime rules are accordingly conceptualised as a process of negotiation and sense-making. This is reiterated by Shove and Walker (2007b) who argue that rules are subject to ambiguity and are interpreted, negotiated and transformed by actors and organisations. This debate is mirrored in wider literature related to regulation, which present opposing views on agency in regulatory compliance (Haines, 2011). Notably, Haines (2011) highlights that the agency of actors is often constrained by the structures and cultures of the organisations they are embedded in. Thus, implementing agents prioritise reproducing the legitimacy of their organisation over implementing rules that may reduce organisational and societal risk. In response to these debates, this thesis seeks to explore the extent to which regulatory rules are shaped, negotiated and produced within organisational settings and reproduced through practices.

Five, related to the organisational theme of this study, this thesis explores the implementation and interpretation of rules in implementation settings. In order to explore the relationship between rules and organisational settings, it is possible to draw from a range of diverse fields. Theory (and practice) stemming from relevant fields such as urban climate governance (Betsill and Bulkeley, 2010) and energy studies (Rutter and Keirstead, 2012) place importance on the relationship between regulation and organisational settings. This is because implementing agents are



embedded in organisational settings which shape the ways in which they interpret, implement and engage with rules and the means, motivations and capacities they have to comply with rules (LaBelle, 2012). Notably, innovation management and strategic niche management highlight that transitions require organisational 'space' for and 'incubation' of niche innovations. Thus, rules that are blind to organisational settings and institutional risks seldom succeed (Kemp et al., 1998). Further, research related to sustainable energy transitions highlight that regulatory instruments that ignore the organisational settings in which implementation occurs often create challenges for implementing agents (Fontaine, 2010). Conversely, where regulatory reform is accompanied by institutional change there is greater probability of success in implementation (Tsoutsos and Stamboulis, 2005). This is particularly stressed in research related to electricity infrastructure reform.

Organisational theory, particularly related to the local government applies the concept of formalisation of rules as a means of understanding the ways in which rules become entrenched in organisations. According to Hage and Aiken (1967) the formalisation of rules is a structural variable for the behaviour of members of an organisation. The degree of formalisation within an organisation impacts on the extent of the discretion of actors. High levels of formalisation can have a constraining effect in that organisational actors are coerced into compliance (Adler and Borys, 1996). Formalisation is linked with centralisation. In organisations with centralised decision-making, formal rules are more prevalent. Further, formalisation of rules has an inverse relationship with the ability to change. Ostrom et al. (1999) argue that a high degree of formalisation creates a vicious cycle, where organisational actors follow rules for the sake of the rules themselves. Accordingly, formalisation of rules may potentially constrain innovation and the capacity for socio-technical change. This is important for this study, which focuses on the ways in which rules constrain or enable organisational and wider socio-technical change.

Further, in exploring rules in organisational settings, useful lessons can be drawn from research on regulatory barriers commonplace in urban transitions (DeAngelo and Harvey, 1998), multi-level climate governance (Alber and Kern, 2008), socio-ecological resilience (Gunderson, 2000) and sustainable energy studies (Verbruggen and Lauber, 2012). The common theme in these fields is that regulation is either framed as a barrier to sustainable change, or where regulation is intended to govern sustainable change, established institutions or incumbent regimes resist these rules. However, studies that evaluate barriers to sustainable transitions tend to cluster all barriers related to rules in a single category of 'regulatory barriers'. This fails to properly understand the complexities and root causes of regulatory barriers. In contrast to a uniform approach to barriers, Nykamp et al. (2012) provide a complex account and method of analysing regulatory barriers to

sustainable energy transitions. Verbruggen and Lauber (2012) further submit that barrier analysis in relation to sustainable technologies should consider a range of diverse and interconnected factors including policy and institutional environments, wider and coupled regulatory systems, socio-economic potentials of a technology, cost implications and intersection of sustainable technologies within existing regimes. Painuly (2001) further provides a useful framework for exploring regulatory barriers at a range of levels, including barrier categories, barrier elements and barrier dimensions.

Six, this study explores tensions between top-down formal rules and bottom-up responses. There is a significant body of theory related to regulation that transition theories could potentially draw from in this regard. To begin with, valuable learnings can be drawn from responsive regulation, specifically in view of the Global South focus of this study. Responsive regulation, grounded in developing state contexts, highlights that both state and non-state actors engage in regulating behaviour (Ayres, 2013; Ayres and Braithwaite, 1992; Braithwaite, 2006). Grabosky (2012) emphasises that developing states with limited regulatory capacity mobilise cheaper forms of social control than command and control regulation. They enrol NGOs, industry associations, academia, professionals and international organisations in regulating behaviour (Grabosky, 2012). In these contexts, formal rules are less important in facilitating change (Braithwaite, 2006) and are regarded as only one element of regulation. Haines and Sutton (2003) further highlight the impact of being over-prescriptive in regulating change, whereby implementing agents become overwhelmed by a plethora of rules and standards. This, in fact, undermines compliance and the goals of regulation. Responsive regulation further stresses that interpretations of rules that matter do not come from formal legal systems but rather actors. It is thus relevant and crucial to examine regulatory pluralism in contexts of deregulation and privatisation in network infrastructure and in relation to complex challenges (Selznick, 1992: 470).

Diverse fields of relevant research theorise and describe similar regulatory modalities. For instance, urban climate change research highlights the role of networks of actors in responding to the regulatory void in climate action. Several sustainable transition cases highlight that the rise of private-driven sustainable transition activities stems from the hollowing out of state regulatory capacity (Hodson and Marvin, 2010; Bartley, 2003; Jaglin, 2010). Sustainable energy researchers emphasise the role of technology and 'the democratisation of technology' in increasing the regulatory capacity of non-state actors (Van den Bergh et al., 2007). Research in environmental security further explores nodal and polycentric regulatory concepts. Braithwaite (2006) submits that the presence of regulatory pluralism thus requires the examination of contestation in regulatory spaces. Durant et al. (2004) hold that regulatory pluralism requires examination of the

extent to which regulatory activities undertaken by networks are orchestrated or coordinated. Similarly, regulatory coordination by loose networks of actors is examined by several MLP authors (Smith and Stirling, 2008), urban transitions scholars (O'Brien and Hope, 2010) and multi-level climate governance studies (Bulkeley and Betsill, 2005). These share similarities with concepts such as facilitative regulation, responsive regulation (Ayres and Braithwaite, 1992), management-based regulation (Coglianese and Lazer, 2003) new environmental governance (Holley et al., 2011) and experimentalism (de Búrca, 2010), which focus on analysing the ability of regulatory instruments to respond in an adaptive manner, in contrast to command and control rules.

Finally, this study explores, on the periphery, regulation of complex coupled systems. There is a growing body of research in this regard that stem from critiques of the incompatibilities between formal rules and command and control, on the one hand, and the need to govern complex socio-ecological or socio-technical challenges on the other. For instance, Ebbesson (2010) queries whether

the notions of “the rule of law” and legal certainty are at all compatible with the objective of promoting sustainable utilisation of natural resources and the ability to sustain and absorb disturbances and complex changes? Does legal certainty imply a too rigid approach to cope with uncertainties and complexities? (ibid: 415)

Several relevant disciplines explore a systems approach to regulation including research on socio-ecological resilience, sustainable infrastructure systems, environmental security, climate change (Haines and Reichman, 2008), urban transitions and energy systems. Fiorino (1999) propose reflexive law in response to sustainability challenges. Reflexive law pays greater attention to incentives and procedures that influence actors to behave in specific ways and to reflect on such action (Haines, 2011). Thus, command and control rules are replaced with more abstract forms of regulatory control that enhance reflective mechanisms and encourage desired behaviours. Regulation is viewed as a means to create learning processes rather than to achieve the best results in advance. Similarly, Gunningham and Grabosky (1998) argue for regulatory systems based on context and local characteristics, preferring complementary instrument mixes over single approaches. Regulations is thus about responsiveness, creating early warning (through triggers) of regulatory failure and maximising opportunities for win-win outcomes. Ostrom *et al.* (1999) argue that markets cannot solely be relied upon to deliver win-win outcomes and government intervention is necessary to increase the uptake of sustainable technologies.

A central argument cutting across these fields is that top-down regulation is the antithesis of the flexibility and responsive decision-making required for governing complex and dynamic systems (Haines, 2011; Gunningham and Grabosky, 1998; Ostrom, 1999). In response, these scholars highlight elements of a regulatory system required for coping with socio-technical or socio-

ecological change. These include rule systems that are adaptive, context-specific and flexible (Haines and Sutton, 2003); that promote open institutions (Tsoutsos and Stamboulis, 2005), broad participation and multilevel governance; and facilitate institutional learning.

## 2.6. Organisations and the multi-level perspective

Given the identified limitations of transition theories in general and the MLP in particular to engage with the role of organisations, this section seeks to develop a framework for exploring the relationship between organisations and regimes. In focusing on organisations, there are several sub-themes emerging from the literature that will be explored further in the thesis. These include the role of state organisations in transitions, the impact of organisational functions, structure and culture in socio-technical regime reproduction and change, organisational risk, and politics and power in relation to municipalities. This section outlines the ways in which the MLP conceptualises these sub-themes alongside a range of concepts and ideas that may be valuable in exploring organisations through an MLP lens.

First, related to the role of organisations in regime reproduction and change, there is much debate regarding structure-agency amongst sustainable transition scholars. However, in general, sustainable transition studies are criticised for an overtly structuralist approach. Typically, sustainable transition studies regard regimes as monolithic structures that cannot be significantly influenced by actors or organisations (Smith and Stirling, 2005; Geels, 2004). In response to the neglect of agency, Smith and Stirling (2008) provide a framework for examining agency of actors in influencing transitions. They define agency as the ability to intervene and influence regime reproduction or change. Agency is constituted by capacity and capability referred to as adaptive capacity. Actors can influence change through either enhancing the articulation of selection pressures or improving adaptive capacity. On the other hand, capacity to influence change requires organisational power. Yet, transition authors are largely silent on agency of organisations, particularly state agencies that play a role in regime reproduction or change. Accordingly, this thesis seeks to explore and describe the capacity of the state, specifically local government, to influence transitions.

In the above aim, conceptualisation of government organisations as ‘agents of change’ is relevant. Hall (1999) argues that whenever a government agency is set up with the purpose of implementing a new agenda, it becomes a social change agent. Conversely, state organisations are by their very nature conservative and are often resisters of change (Lipset, 1960; Ostrom, 2009; Pieterse, 2012) particularly in relation to infrastructure service provision (Gratwick and Eberhard, 2008; Jaglin, 2008). Dauber et al. (2012) highlight that government agencies are both passive and active

participants in social change. Society is impacted by both internal changes within organisations as well as by organisations that actively seek change. Scholars across disciplines have shown a multitude of ways that internal change within state organisation can foster socio-technical change. Multi-level climate governance scholars demonstrate the ways in which change in membership within organisations, notably employment of climate activists in government departments, stimulate local climate action (Roberts, 2008; Bulkeley and Betsill, 2005). Strategic niche management and innovation studies highlight ways in which change in the patterns, functions and priorities of work within organisations impact on broader socio-technical change (Kemp and Hoogma, 1998; Schot and Geels, 2008). Resilience authors demonstrate ways in which organisational change in state agencies, towards more adaptive management, improves sustainability outcomes (Walker et al., 2004). Moreover, there is a considerable body of work stemming from sustainable energy studies that highlights the importance of organisational reform in state agencies responsible for energy planning and management.

Second, this study explores the impact of organisational functions and structures on regime reproduction and change. Geels (2002) touches on the role of organisational functions and structures in stabilising socio-technical regimes through borrowing concepts such as ‘genetic structure’ and cognitive routines in understanding socio-technical reproduction (Nelson and Winter, 1982). There are several concepts, stemming from organisational theory related to government agencies that may be used to conceptually bridge the relationship between organisational structure and function and broader socio-technical change. Breward et al. (2016) outlines six elements within organisational structure including centralisation, span of control, formalisation of rules, division of labour (specialisation), departmentalisation and chain of command. These will be used in an organisational analysis of the City’s structure and its influence on transitions. It is thus necessary to briefly outline the way in which these elements are described in relevant theory.

Centralisation is a potentially valuable concept for understanding regimes and transitions of network infrastructure. Centralisation of power is explored in more traditional organisational theory related to the state as well as a diverse range of sustainability disciplines including resilience, climate change governance, energy studies and political ecology. Centralisation relates to the distribution of power within an organisation (Ostrom et al., 1999) whereby the greater the level of participation by a number of groups in an organisation, the less centralised it is (Van de Ven and Ferry, 1980). According to Ostrom et al. (1999) high levels of centralisation mean greater coordination but less flexibility. Policies stemming from centralised organisations may thus be inappropriate for managing socio-technical change (Voß and Bornemann, 2011).

Departmentalisation is inversely correlated to the concept of organisational integration defined as 'the quality of the state of collaboration that exists among departments' (Lawrence and Lorsch, 1967: 11). Departmentalisation and integration are important concepts for exploring local government-led transitions, which require collaboration across state functions and departments as well as coordination with non-state actors. The role of integration has been explored by urban transition scholars, notably in research by Hodson and Marvin (2010). Division of labour may also impact on urban transitions. The notion of organisational complexity is useful in this regard. Hall (1999) identifies a number of elements of organisational complexity including horizontal and vertical differentiation. Horizontal differentiation refers to division of labour and the extent of specialisation in an organisation. Vertical differentiation examines the 'depth of hierarchy' within an organisation. Authors across disciplines have examined the ways in which organisational hierarchies and division of labour impact on sustainable outcomes. This includes research on renewable energy (Painuly, 2001), infrastructure transitions (Swilling, 2011), socio-ecological resilience (Gunderson, 2000), and strategic niche management (Kemp et al., 1998). Urban transition and multi-level climate governance scholars demonstrate that local governments exhibit high levels of differentiation and thus struggle to integrate diverse values, proposals and ideas that stem from their members (Monstadt, 2007; Alber and Kern, 2008).

A range of further components of organisational structures is potentially important for understanding urban energy transitions including limitations on authority, the scale and size of the organisation (Blau and Schoenherr, 1971), financial and budget structures, technical competency and the extent of established rules and procedures (Weber, 1947). There is also a significant body of research on the influence of capacity or lack thereof on stifling or enabling socio-technical change in areas such as sustainable energy development (Mulugetta, 2007), urban network infrastructure reconfiguration (Swilling, 2010) and local climate action (Roberts, 2008). A multitude of authors have further explored the relationship between organisational structures and functions and sustainable change in disciplines such as resilience (Walker et al., 2004), multi-level climate governance (Barrett, 2013), energy transitions (Páez, 2007) and innovation studies (Schot and Geels, 2008).

Third, this study explores the relationship between organisational cultures and socio-technical change. Authors across disciplines demonstrate that organisational culture heavily impacts on the ability of organisations to facilitate wider social or environmental change. Notably, research has highlighted the ways in which organisational cultures impact on urban climate policy and implementation (Froestad et al., 2012); reconfigurations of sustainable network infrastructure (Doughman, 2009); and energy transitions (O'Brien and Hope, 2010). Froestad et al. (2012) for

instance show that structural 'differentiation' has resulted in different institutional cultures in separate departments in the City related to, *inter alia*, attitudes, behaviour, goal orientation, time perspectives and values. This thesis draws upon various elements of organisational culture identified in literature in order to analyse the organisational culture of the City and its impact on socio-technical change. These elements include values, management style, knowledge, distance from power, uncertainty avoidance, dominant rationality, basic assumptions, policy means and Confucius Dynamics (Beward et al., 2016).

Four, this study explores the impact and influence of politics and power on transitions, referring to both 'office-based politics' or politics within formal institutions (Patel et al., 2016) within the City and broader politics of sustainable transitions defined as the 'unruly' attempt at shaping the framework and outcome of sustainability governance to serve particular actors, interests, beliefs and agendas (Meadowcroft, 2009). Thus, it is necessary to briefly outline how transition theories conceptualise politics and power. In general, themes of power and politics have been largely neglected in various STS frameworks, apart from notable contributions by Murphy (2015), Voß and Bornemann (2011), Scrase and Smith (2008), Lawhon and Murphy (2011), Smith and Stirling (2008). Lawhon and Murphy (2011) argue that improper engagement with power and politics has resulted in a 'narrow and rather apolitical lens on the processes that shape socio-technical transitions' (ibid: 363). Notably, transition studies seldom focus on the outcomes of government decision-making processes and their impact on 'realignment of power'. Shove and Walker (2007) argue that conflicts and power struggles are intrinsic to sustainability decision-making as it involves issues of resource distribution and access. Thus, environmental and sustainability decisions are highly shaped by and embedded within politics. Voß and Bornemann (2011: 11) assert that politics related to sustainability decision-making involves discourses, engagements and contestation amongst individual and organisational actors for 'the definition and the provision of the common good'. Notably, Murphy (2015) provides a basis to explore the politics and conflicts of transitions by offering a framework that concentrates on 'the place-framing and making activities that coalitions of actors use to advance socio-economic, political, and environmental agendas' (Murphy, 2015: 88). This understands the politics of transitions as networked political processes whereby proponents of competing visions contest over the scope, direction and pace of development and socio-technical change. This conceptualisation encourages the examination of the role of a diverse set of actors in transition processes. Smith and Stirling (2008) further introduce concepts of power to transition studies through notions of regime membership and resource interdependencies as a means to explore the extent of power and influence specific actors have in reproducing or maintaining regime function.

This study applies a range of concepts, stemming from organisational theory, related to power, within an overall STS framework. Morgan (1986) provides a useful classification of power relationships in government organisations. State entities may be bureaucracies, technocracies, governed by co-determination or representative democracies. In bureaucracies, rules, roles and hierarchies are clearly defined and codified whereas technical expertise forms the basis of technocracies. Co-determination involves shared ruling systems, between opposing parties, within an organisation. Representative democracies involve elected officers that serve specific terms based on support by electorates. Local governments are usually mixed types that exhibit multiple forms of rule (Bulkeley and Betsill, 2010). In bureaucracies, power is hierarchic with each level given the sufficient amount of power necessary to carry out responsibilities (DiMaggio and Powell, 1983). In practice, however, power arrangements are structured around informal patterns established over time and by contestation in the exercise of power amongst individuals in bureaucracies (Hall, 1999).

Social ecologists (Foster, 1999) differentiate between rational-legal or charismatic authority in relation to environmental decision-making. Rational-legal authority is based on acceptance, by subordinates, of legitimate authority of those in higher offices. Charismatic authority, on the other hand, relates to devotion of a power holder based on their personal characteristics. A Weberian (1947) classification of different typologies of authority may also be useful in examining powers of negotiation amongst different social groupings and associated mechanisms used to either reproduce or change regimes. Similarly, MLCG and urban transition authors have highlighted the role of charismatic leadership, 'champions', pioneers or public entrepreneurs in transitions and the ways in which rational-legal authority in local governments stifle innovation. Bacharach and Lawler (1980) further distinguish between different sources of organisational power, namely: structural position, personal characteristics, expertise and opportunity. Pfeffer (1994) highlight that budgetary allocations and policy priorities are important catalysts for power struggles in state agencies. Such power dynamics have been well documented in urban transition (Davison et al., 2015) and multi-level climate governance research (Roberts, 2008).

Finally, this thesis seeks to explore the ways in which urban actors govern urban transitions. This is a periphery exploration of this study that cuts across all four themes. It is thus necessary to briefly outline the theory on the governance of transitions and associated critiques. The main body of research related to the governance of socio-technical transitions is referred to as transition management. Transition management is an openly normative approach to steering technological change (Genus and Coles, 2008). It is concerned with examining policy interventions required to guide socio-technical systems to more sustainable configurations (Smith and Stirling, 2010).



Transition management postulates regime change based on consensus and negotiation, which results in a guiding transition vision (Smith and Stirling, 2010). Visioning is a central part of transition management and a tool used to create a shared understanding of different interests (Hodson and Marvin, 2010).

Many critiques have been levelled at transition management on both theoretical grounds and the form it has taken in practice. Transition management has manifested in the institutional structure of a 'transition arena' made up of a small group of technical experts. This arena develops a vision, proposed trajectory and tools for intervention, which are then lobbied to decision-makers and implemented by different social groupings. This has been criticised as undemocratic, technocratic and elitist (Genus and Coles, 2008). Notably, proponents of transition management do not clarify the ways in which the governance of transitions interacts with wider political and policy processes and existing government decision-making structures. Accordingly, structures to ensure legitimacy, accountability and proper delegation of power are opaque in the governance of transitions. In relation to urban transitions, Myers (2014a) highlights that shared visions are unlikely to succeed in contexts of deep structural inequalities present in African cities. Lawhon and Murphy (2011) particularly criticise the lack of participation in visioning and inadequate attention to power. Importantly, the success of system change is highly dependent on the involvement of incumbent regimes, as they are central to regime reproduction. However, incumbent regime members wield considerable power. Their Involvement thus opens up significant risk of capturing (Hendriks, 2008) obstructing and influencing (Smith and Stirling (2010) transition processes.

*Table 2.1: Summary of conceptual framework and literature*

Conceptual theme	Sub-theme	Authors
Historical transitions	Epochal transitions	Fischer-Kowalski and Haberl, 2007
	Industrial transitions	Perez, 2002; Siefert, 2001
	Historical energy transitions	Smil, 1994; Mokyr, 1999
Sustainable innovations and systems in transition	Innovation studies	Breschi and Malerba, 1997
	Sectoral systems of innovation	Dosi, 1982
	Technological systems	Kemp, 1997
Multi-level perspective	Large technical systems	Coutard, 1999; Hughes, 1987
	Multi-level perspective on socio-technical systems and regime change	Geels, 2002; Geels, 2004; Rip and Kemp, 2002; Geels and Schot, 2007; Smith and Stirling, 2008; Smith et al., 2005; Smith and Grin, 2010
	Regime transformation typologies	Berkhout et al., 2004
Transitions and systems theory	Transition pathways	Geels and Schot, 2007
	Emergence, path dependency, lock-in, non-linear change	Holland, 1995; Sayer, 2000; Kauffman, 1993; Walby, 2007
	Equilibrium, stable states and feedback loops	Capra, 1982; Arthur, 1994

Sustainable transformations and economics	Evolutionary theory and transitions	Parsons, 1951; Rip, 1995
	Critiques of neoliberal basis of sustainability science and governance	Runnals, 2011; Hardin, 2003; Spash, 2011; Hoffmann, 2011
	Degrowth and social ecology	Fournier, 2008; Demaria et al., 2013; Gare, 2000; Foster, 1999
Resilience and transitions	Socio-ecological systems and resilience	Gunderson, 2000; Carpenter, 2003; Elmqvist, 2000; Folke et al., 2004
Transitions and social construction of technology	Social construction of technology (SCOT), Constructive technology assessment (CTA) and actor network theory (ANT)	Bijker, 1995; Griffith and Dougherty, 2002; Kaghan and Bowker, 2001; Freudenburg, et al., 1995; Rice, 2013; Pickering, 1995
Transitions and conflict theory	Marxism and Hegelian Marxism	Foster, 1999; Nadasky, 2007; Gramsci, 1932; Walby, 2008; Jarvikoski, 1996
Sustainable transitions in the global south	Global South based critiques of sustainable transitions	Lawhon and Murphy, 2011; Hendriks; 2009; Meadowcroft, 2009; Genus and Coles, 2008; Monstadt, 2009; Murphy, 2015; Shove and Walker, 2007b; Myers, 2014b; Huesmann and Huesmann, 2011; Boulanger, 2010
	Ecological modernism	Janicke, 2008; Ehrenfeld, 2004; James, 1997; Nielsen, 2007
	Political ecology	Watts and Peet, 2004; Myers, 2014b; Bryant and Bailey, 1997; Swyngedouw, 2006
	Just Sustainabilities and Just Transitions	Scholsberg, 1999; Agyeman, 2005; Swilling and Annecke, 2012
	Environmental justice	Schlosberg, 2007; Patel, 2014; Barrett, 2013; Dobson, 1999
Scale and urban transitions	Scale and the multi-level perspective	Coenen and Truffer, 2012; Murphy, 2015; Coenen and Hansen, 2015
	Urban transitions	Hodson and Marvin, 2009a, 2009b, 2010; Bulkeley and Betsill, 2003, 2005;; Silver and Marvin, 2016; Monstadt, 2007; Graham and Marvin, 2001
	Transitions and decentralised government	Späth and Rohrer, 2012; Truffer et al., 2008; Hooge and Marks, 2003
	Multi multi-level climate governance and transitions	Bulkeley and Betsill, 2003; Bulkeley and Kern, 2006; Bulkeley and Betsill, 2005
	African urbanism, radical incrementalism, UPE, Alternative Urban Development Frameworks, splintered urbanism	Myers, 2008; Patel, 2014; Parnell and Pieterse, 2014; Myers, 2011; Pieterse, 2012, 2014; Graham and Marvin, 2001; Jaglin, 2008; Monstadt, 2009; Lawhon et al., 2014
Regulation and regimes	Rule types	Geels, 2007; Scott, 1995; Rice, 2013; Parsons, 1937
	Regulation and innovation	Dewick and Miozzo, 2002; Ford, 2013

Organisations and transitions	Regulatory autonomy of spheres of government	Alber and Kern, 2008; Schreurs, 2008
	Regulation and agency	Kemp and Loorbach, 2006; Haines, 2011
	Interpretation of rules	LaBelle, 2012; Tsoutsos and Stamboulis, 2005; Hage and Aiken, 1967; Ostrom et al., 1999; Verbruggen and Lauber, 2012
	Responsive regulation	Ayres, 2013; Ayres and Braithwaite, 1992; Braithwaite, 2006; Grabosky, 2012
	Socio-technical systems and organisational agency	Smith and Stirling, 2005; Hall, 1999; Lipset, 1960; Ostrom, 2009
	Organisational structure and function and transitions	Nelson and Winter, 1982; Breward et al., 2016; Van de Ven and Ferry, 1980; Ostrom et al., 1999; Lawrence and Lorsch, 1967
	Organisational cultures and socio-technical change	Froestad et al., 2012; Doughman, 2009
	Politics and power and transitions	Patel et al., 2016; Voß and Bornemann, 2011; Scrase and Smith, 2008; Lawhon and Murphy, 2011; Smith and Stirling, 2008; Morgan, 1986; Foster, 1999; Weber, 1947

## 2.7. Conclusion

This chapter sought to develop a framework to explore the four themes and enquiries of this study. It provided a theoretical framework, through identifying gaps, debates and sub-themes in sustainable transition theory related to the Global South, cities, regulation and organisations. This chapter further outlined critiques, counter frameworks and alternative positions related to each of these themes. Further, it provided concepts and ideas that will, to varying degrees, frame the results of this study. A review of the literature highlights that these themes have been explored, to varying degrees, in sustainable transition theory. It is evident that there is increasing interest, cases and theorising on urban transitions from the perspective of cities in the Global South and growing interest in exploring infrastructure networks in African cities. However, there are gaps and areas of interest that come to the fore that provide the basis for the conceptual frame of this thesis.

First, in relation to scale (urban) and geographic context (Global South), there are notable gaps related to the way in which various frameworks in sustainable transition theory conceptualise issues of power, contestation, inequality, poverty and resource control. There is much value that may be gained from exploring, *inter alia*, the political economies and developmental contexts in which regimes are embedded; the role of the state in transitions; biases in the framing of

sustainability; the specificities of infrastructure networks in the Global South; transitions in the context of utility restructuring; and interactions between urban and national transitions.

Second, concepts and ideas to explore pathways and typologies of regime transformations in a city in the Global South were outlined. The gaps and critiques that this study seeks to engage with within this theme are as follows. First, due to its quasi-evolutionary underpinning, the role of market-driven innovation is regarded as central to transitions. This pays little attention to the actions of movements, civil society and the state and elevates the roles of markets as a key determinant. This is problematic for evaluating regimes in contexts where the state plays a more central role in the provision of network services. Second, using a constructivist approach to understanding socio-technical regimes may enable exploration of multiple potential socio-technical pathways and the socio-economic impacts of different configurations. Third, sustainable transition theory does not examine non-linear rupture of regimes and associated socio-economic impacts. Four, the classification of reconfiguration processes developed transition scholars pay little attention to the socio-economic impacts and outcomes of transition processes.

Third, this chapter outlined a conceptual framework to explore the relationship between rules and regime change. Sub-themes identified, that will be engaged with in this study, include: the extent to which top-down rules structure regime stability and change; regulatory coherence and alignment of regime rules; interactions between national and urban transitions; issues of agency in relation to regime rules; implementation of regime rules within organisational settings and tensions between top-down formal rules and bottom-up responses.

Finally, this chapter provided a framework in which to examine regimes through an organisational lens, focusing on the state (local government) in order to investigate the influence of organisational conditions related to structure, function, culture and politics and power on socio-technical regime reproduction and change. This has not been sufficiently examined in transition theories.

## Chapter 3: Methodology

### 3.1. Methodological approach

The methodological approach of this study was selected to address the specific research questions and themes. In general, the themes of this study deal with conditions for change in complex socio-technical systems. In particular, these questions required a deep and rich investigation into four themes, namely: scale (urban), regulation, organisational conditions and geographical context (Global South). It is widely held that a qualitative approach is best suited for enquiries of this nature (Crabtree and Miller, 1999) as it allows for an exploration of interrelated and complex social phenomena (Atkinson and Hammersley, 1994), such as the conditions under which coupled socio-technical systems transition. Qualitative research is holistic (Terre Blanch et al., 2004) and the enquiry of this thesis, by its very nature, can only be investigated using a holistic and inductive approach inherent in qualitative research.

Within an overall qualitative paradigm, a case study - the City's electricity system - was selected to explore the themes and research questions of this study. In exploring this case, the research was undertaken using a participatory, engaged and grounded theory (GT) approach. Notably, the research was conducted within a knowledge co-production setting and research programme, which significantly informed the methodological strategy.

#### 3.1.1. A case for exploring urban transitions in the Global South

The rationale for selecting the City of Cape Town as a case is briefly outlined in Chapter 1. The following chapter (Chapter 4) provides further context to the case in relation to the themes of this study. Specifically, the case, the City's electricity system, refers to the electricity system operated and managed by the metropolitan municipality that governs the city of Cape Town. In terms of political management, the City is governed by a 231-member City Council elected in a system of proportional representation.<sup>10</sup> The administration is made up of 11 directorates and 38 departments. The main organisational units in the City involved with the electricity system are the Utilities Directorate in general and Electricity Department in particular, the Utilities Portfolio Committee, the Energy Committee and the Energy and Climate Change Unit in the Environmental Resource Management Department. Of importance, both the City and Eskom distribute electricity

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<sup>10</sup> The executive authority vests in an Executive Mayor who in turn appoints a Mayoral Committee (Mayco) whose members oversee various portfolios.

in the city of Cape Town. The City distributes three quarter of total consumption in Cape Town, whereas Eskom is responsible for the remaining quarter (CCT, 2011e).

Using a case study in general and the City of Cape Town in particular was regarded as suitable for the enquiries of this study for a range of reasons. First, a case and site were needed to investigate the manifestation of change in a socio-technical system within an urban, Global South geography, from the perspective of a municipality. Second, the research questions required rich longitudinal information and data in order to assess the implications of applying the MLP in the Global South. This is the type of information and data that a case could provide (Duminy et al., 2014). Third, a case is a means to summarise the key arguments within a specific area of research (Stake, 1994). In relation to the research questions, it was felt that a case could potentially highlight key arguments and enable critical reflection on transitions in Global South contexts (Duminy et al., 2014), the relationship between 'cities' and the niche-regime-landscape hierarchy and the role of regulation and organisational conditions in constraining or enabling sustainable transitions. A case could thus be used to promote critical reflection on existing theory (transition theories) and allow novel ideas to emerge from detailed observation (Baxter and Jack, 2008; Lincoln and Denzin, 1994).

Importantly, a case study is a powerful method to identify new insights in relation to existing theory. Such a theory-building case study can be described as a heuristic case. As noted by George and Bennett (2005: 77) outlier cases are particularly well suited for heuristic case studies as 'their outcomes are not what traditional theories would anticipate'. Although not strictly an outlier, as various cases theorise on transitions from the perspective of a city in the Global South, the City of Cape Town offers new variables that have not been sufficiently 'anticipated' (Duminy et al., 2014; George and Bennett, 2005) in sustainable transition theory (Lawhon and Murphy, 2011; Hodson and Marvin, 2010). It is thus a useful site for exploring contextual conditions (Crabtree and Miller, 1999) and novel variables, including *inter alia* energy poverty and inequality, cross-subsidy systems, policy aimed at redistribution, issues of access to infrastructure and the beneficiaries of reconfigurations and examining the insights these conditions could offer transition theories.

The themes of this study require an examination of, *inter alia*, the ways in which actors involved in the City's electricity system interpret and implement rules; the values and belief systems that underpin decisions; the organisational cultures and structures that constrain or enable change and the ways in which actors navigate and influence change within a complex social, technical, regulatory and organisational landscape. This is in essence constructivist approach to researching and understanding regimes (Genus and Coles, 2008), where much of the focus is on the social construction of a system (Searle, 1995). In this regard, a case study allows collaboration between the researcher and participant and enables participants to narrate their stories and describe their

views of reality (Crabtree and Miller, 1999). This enables a better understanding of the motives and actions of participants (Tashakkori and Teddlie, 1998) in relation to socio-technical reproduction and change. Notably, as a central critique of the MLP relates to an overly structuralist conception of socio-technical systems, a case study allows an exploration into subjective construction of meaning (Crabtree and Miller, 1999) with a focus on the dynamic tensions between structure and agency.

Consideration was given to whether comparative cases or multiple case studies should be undertaken. However, it was recognised early in field work that due to the heterogeneity within the City's administration and the diversity in projects and programmes pursued by the City related to energy and climate change, a single case with 'embedded units' (Duminy et al., 2014; Crabtree and Miller, 1999) would be both feasible and desirable. According to Baxter and Jack (2008), exploring sub-units situated within a larger case enables a more complete understanding of the case and allows for analysis of separate sub-units (within case analysis), comparisons between sub-units (between case analysis) and across sub-units (cross-case analysis). In this study such an approach was utilised in two ways. First, it was necessary to thoroughly explore positions of different departments and functional units within the City. These different departments acted as sub-units. Second, several 'sustainable energy' projects, policies and programmes that the City is pursuing were explored in greater detail. These included the ECAP; Small-Scale Embedded Generation project and policy; a programme to pursue large-scale renewable and clean energy supply; programmes to promote city-wide uptake of energy efficiency including the Electricity Savings Campaign, Resource Efficient Development Policy and Mass Solar Water Heater Roll-out Programme; projects related to ripple control and the roll-out of smart meters and the Municipal Energy Efficiency and Demand-side Management Programme. These provided strong sub-units to better illuminate the overall case and allowed for between and cross-case analysis.

Two limitations of case studies identified in theory and the implications of these for this study require reflections. First, the insights from a case may not always be generalisable for theory (Lincoln and Denzin, 1994). In particular, this study sought to examine conditions common to cities in the Global South in relation to energy infrastructure and the insights these could offer transition theories. However, it is arguable that Cape Town is not the best exemplar of a city in the Global South due to its established and well-serviced electricity grid and considerable resources to maintain its electricity infrastructure. Nevertheless, the City provides a strong case for exploring inequality and marginalisation in relation to infrastructure provision (Duminy et al., 2014). The limitations of using the City as a case were thus weighed against the value of gaining a rich and in-depth understanding (Lincoln and Denzin, 1994) of the potential insights that could be highlighted

by using Cape Town as case. Further, the moderate constructivist leaning of this case study starts from a position that phenomena are context specific and thus rather than absolute general laws, only aspects of the case can be regarded as an instance of a broader recognisable set of features (Williams, 2002).

Second, the challenges of bounding a case are commonly identified in literature (Crabtree and Miller, 1999). Such challenges are specifically highlighted in relation to transition theories. Genus and Coles (2008) for instance argue that case studies using the MLP seldom specify the conceptual elements of the MLP that are being used and are unclear around bounding of cases. This leaves doubt as to whether the MLP has been properly applied in particular cases. Thus, Genus and Coles (2008) argue that cases using the MLP should properly identify and explain the selection of case studies; collection of case data; and defining the start and end points of a transition case. In response, the importance of bounding the case was acknowledged and considered in research design. First, it was necessary to bound and describe the regime under analysis. This description and bounding of the City's electricity regime is outlined in Chapter 5<sup>11</sup>. Second, it was necessary to bind the case in terms of time and place (Creswell, 2003) and by context (Miles and Huberman, 1984). Thus, the study focused primarily on the City of Cape Town's (place) electricity distribution system (regime) during my period of fieldwork between 2012 and 2015 (time). As highlighted by Baxter and Jack (2008), binding a case according to specific issues ensures that it remains within feasible limits. Thus, a further means used to bind the case was a focus on and prioritisation of data collection and analysis related to the specific issues (Stake, 1994) or themes of this study<sup>12</sup>.

### 3.1.2. Participant observation

There are several reasons why participant observation is well suited to the research questions and themes of this study. First, participant observation acknowledges the 'messiness' of local settings and complex problems (Payne and Payne, 2004). Epistemologically, participant observation regards reality as complex, dynamic and interconnected (Terre Blanche et al., 2004). It is widely regarded as a robust approach to investigating complex problems that do not easily lend themselves to analysis from one discipline. Thus, it is well suited to research questions that span disciplines and are contextual and systems-based. These are precisely the type of themes this study seeks to explore.

Second, participant observation places significant value in the practical knowledge of participants and testing assumptions and the validity of research in a local context (Atkinson and Hammersley,

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<sup>11</sup> See section 5.2

<sup>12</sup> Regulation, scale, geographical context and organisations



1994). It is 'context bound' and treats diversity in knowledge and forms of knowledge as an opportunity to enrich research (Latour, 2005). This directly speaks to a central aim of this study, i.e. to examine the implications of context (Global South) and complex social settings (organisations and regulation) to theory on socio-technical change. Participant observation was thus appropriate in exploring these questions.

Third, the ways in which participants, rules and organisational structures constrain and enable transitions cannot be considered or understood in the abstract. With participant observation, the researcher takes part in daily activities, interactions and events of a group of people to learn the explicit and tacit aspects of their lives (Spradley, 1997). Thus, participant observation was deemed necessary in order to fully understand how the City's electricity system functions and the conditions, implications and constraints to change in this regime. This in turn required a proper understanding and data of, amongst other issues: how the regime is shaped and reproduced by actors<sup>13</sup> on a daily basis; how actors interpret, negotiate and employ rules (Vinten, 1994; Shove and Walker, 2010); the values and belief systems that underpin decision-making; and the 'interactions and events' that create the conditions for change (Genus and Coles, 2008; Bogdan, 1972). This would be difficult to comprehend without an intimate knowledge and experience of being a participant in this social system.

Participant observation encourages continuous reassessment of research questions and the formulation of new questions that flow from increasing understanding of the context (Vinten, 1994). During this study it became necessary on several occasions to reframe research questions and hypothesis, as more data was collected and analysed. Notably, the ways in which rules, organisational factors, values, belief systems and scale<sup>14</sup> drive or constrain change became increasingly clear the longer I was embedded in the City. These insights would not have been possible without participating in the daily activities of City. In hindsight, it is unlikely that interviews or surveys, without participation, would have provided the type of data that could lead to these insights.

Four, the research questions required data from a local setting that could provide thick insights into theory. Participant observation involves moving between participation and reflection and adapting research to changes in local settings. Accordingly, reflection processes are informed by and follow the emerging patterns of a case. This enables the researcher to practice an iterative relationship between theory and practice, where an emerging theory can be 'subjected to reality testing'. This was critical for the research questions of this study. My participation in the City resulted in a

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<sup>13</sup> Within and external to local government

<sup>14</sup> Particularly tensions between national government and the City

continuous process of prioritising further data collection, testing new hypothesis in the field and reflecting on its application to the MLP. Ultimately, it facilitated constant feedback between theory (the MLP), empirical evidence and the realities of the City. An outcome of participant observation is a reflection by a researcher based on a long-term personal engagement in a local setting. In this study three years of participation in the City allowed for such deep reflection.

Adler and Adler (1987) develop a continuum to describe the intensity of participation. My experience tends to coincide with ‘active participation and membership’ in the group where researchers ‘take on some of the roles of core members’. This is not complete participation or ‘full membership’ where the researcher takes on the identity of the group. In my case, active participation was necessary for building trust and credibility which in turn facilitated access to data, City meetings, workshops and discussions. Recently, researchers have taken ‘active participation’ in a novel direction through exploratory practices such as knowledge co-production and engaged scholarship. Such approaches have specific relevance and origins in examining urban sustainable transitions (May and Perry, 2006; Marvin, 2000, Patel *et al.*, 2015). Knowledge co-production was central to my research.

### 3.1.3. Knowledge co-production

This study was undertaken within the framework of a research programme; the Mistra Urban Futures - Knowledge Transfer Programme (MUF-KTP)<sup>15</sup>. As part of this programme I, along with three other researchers that formed a community of practice, were ‘embedded’ in the City of Cape Town to investigate ‘urban sustainability policy and practice’. The intention of the research programme was to assimilate practical knowledge (tacit) of practitioners and ground it within the theoretical knowledge of the researcher (Patel *et al.*, 2015; Davison *et al.*, 2015). Such an approach is referred to as knowledge co-production or alternatively engaged scholarship, Mode 2 knowledge production, or embedded research.

The theoretical foundation of knowledge co-production requires some elaboration. Academic knowledge<sup>16</sup> and practical knowledge<sup>17</sup> can be regarded as distinct forms of knowledge (May and Perry, 2006; Patel *et al.*, 2015). Each has different ontologies and methods for ‘addressing different questions’ (Hamman and April, 2013). Practitioner knowledge is generated in response to problems encountered in everyday life (Lemos and Morehouse, 2005). Accordingly, practitioners develop a deep and contextual understanding of problems that arise in particular situations and responses

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<sup>15</sup> MUF is an international centre for sustainable urban development. MUF focuses on co-production of knowledge as well as creating Fair, Green and Dense cities for a sustainable urban future. A global arena provides for interaction between the four cities.

<sup>16</sup> Explicit epistemic

<sup>17</sup> Tacit

that may solve these problems (Patel et al., 2015; Anderson et al., 2013). Academic knowledge on the other hand strives towards generalisable theory (Brown-Luthango, 2013). There are widespread calls and arguments related to the value of reconciling these forms of knowledge.

Pettigrew (2001: 61) argues that a 'deeper form of research that engages both academics and practitioners is needed to produce knowledge that meets the dual hurdles of relevance and rigor for theory as well as practice'. Gibbons (2000) makes a strong motivation for the generation of knowledge that is context-sensitive, relevant to pressing social issues, interdisciplinary and reflexive. This is termed 'Mode 2 Knowledge Production', which necessitates greater integration between academia and practitioners. Waghid (2002) argues for broadening the conception of scholarship to include a greater focus on integration, interdisciplinary forms of research collaboration and applied research. Several scholars argue that, rather than reducing rigour and credibility, assimilation of research and practice actually enriches the quality and relevance of research (Schon, 1995; Brown-Luthango, 2013) and complements more traditional modes of knowledge production (Waghid, 2002). In essence, knowledge co-production and engaged scholarship are seen as a means of addressing this theory-practice gap (Patel et al., 2015; Hamman and April, 2013). It is built on a duty to do research that both advances academic knowledge and sheds light on practice within a professional domain (Pieterse, 2014).

A number of characteristics and principles of engaged scholarship and knowledge co-production can be extrapolated from the literature. These principles informed the approach adopted in this study. First, knowledge co-production involves collaborative and mutually defined partnerships between researchers and practitioners (Polk, 2015). It employs inclusive and collaborative strategies to knowledge generation. This creates a learning community that aims to produce knowledge for the benefit of both academia and practice (Brown-Luthango, 2013; Patel et al., 2015).

Second, engaged scholarship is an approach that enables researchers to study complex real-life problems. It is inherently participatory and makes use of different forms of knowledge of diverse participants (Patel et al., 2015; Davison et al., 2015). It is based on the premise that researchers 'can significantly increase the likelihood of advancing fundamental knowledge of a complex phenomenon by engaging others whose perspectives are relevant' and the value of democratisation of research and 'learning by doing' (Van de Ven, 2007: 10). It is cognisant of the rich experiential and embodied knowledge (Soal, 2012; Anderson et al., 2013) of local participants that is gained through extensive experience of complex situations (Greenwood and Levin, 2007).

Third, it is intended to facilitate knowledge generation that is grounded in rich empirical data and experience. As argued by Pieterse, engaged scholarship

demands immersion into profoundly fraught and contested spaces of power and control. It challenges us to think ourselves not apart from the world, but rather deeply and irrevocably caught up in all of its contradictory entanglements (Pieterse, 2014:23).

Authors argue that this does not reduce scientific rigour but rather generates knowledge that is more 'strongly rooted in real-world social dilemmas' (Brown-Luthango, 2013: 5). The proposed outcome for academia is research that is more rich and evidence-based and hence robust (Patel et al., 2015).

But what does knowledge co-production mean in practice, as a method? In practical terms, this meant spending three years in the City (2012-2015), doing research of utility and relevance to the City (practitioners). The program design required an annual seven-five month split, where researchers would spend seven months in the field, embedded in local government doing applied research, followed by five months out of the field. During these years I was embedded in the Energy and Climate Change Unit, where I undertook research to inform City projects and policy related to urban energy and resource sustainability.

During the research period, I (researcher) worked alongside a practitioner (official in the Energy and Climate Change Unit) on a research area that was co-defined by my research interests and questions alongside a requirement of relevance to the City. The data and information generated from my periods of 'embeddedness' thus linked closely to data developed and analysed by practitioners working in the Energy and Climate Change Unit and organisations with which the unit partners and collaborates. This process of co-defining research aims enables common assumptions to be formed.

Primarily, I was involved in research related to the development of two proposed City policies: a Resource Efficient Development Framework and the Internal Energy Management Policy. I further conducted applied research to inform a number of City plans, guidelines and protocols. Notably, engagement in these policy and planning processes facilitated access to meetings, discussions and workshops with officials across the administration and built trust and credibility amongst City staff. This in turn enabled access to data and insights into the policy process, decision-making, interpretation of rules and organisational cultures within and across departments. Further, I conducted applied research that informed the City's inputs into national and provincial regulatory and policy reform in relation to energy and climate change. This provided key insights into the tensions and relationship between national government and the City in relation to urban transitions. Finally, I was involved with research that informed the City's international reporting and

partnerships on energy and climate change. This provided an entry point into understanding the City's engagement with multi-level climate governance.

The initial research questions of this study were fairly open-ended. This is in line with grounded theory, which requires identification of broad areas of interest without making prior assumptions. These broad areas of interest were defined by both theoretical gaps and discussions with experienced practitioners (City officials) who had intimate, albeit tacit knowledge of the manifestation of 'theory in practice'. Several proponents of engaged scholarship outline the value of such an approach to research formulation. Caswill and Shove (2000: 222) argue that complex research questions require engagement with practitioners with diverse functional experiences. Problem formulation for complex problems, accordingly, requires a process of arbitrage and sense-making whereby researchers and practitioners negotiate and co-formulate the problem (Patel et al., 2015). Schon (1995) asserts that, in practical terms, problem formulation in engaged scholarship is guided by both a review of literature (inferring and diagnosing) and by engaging stakeholders who have experience and knowledge of the problem in order to ground the problem in practice.

This is not limited to problem formulation and defining research problems. Rather, it is an iterative process throughout the research. Lindkvist (2005) emphasises the importance of engaging others in theorising. Theory building in engaged scholarship requires communication with 'knowledge experts from relevant disciplines that have addressed the problem' alongside a continuous review of the literature (Van de Ven, 2007: 11). Van de Ven and Johnson (2006: 816) further recommend developing alternative theories to study a problem, as 'multiple frames of reference are needed to understand complex reality'. Engaged scholarship, accordingly, can be regarded as a pluralistic methodology that employs different lenses to understand empirical findings and ensure richer insights.

Knowledge co-production and embedded research in particular has both positive and negative attributes that requires reflection. First, being a participant and active in a space provides the researcher with rich narratives and detailed empirical data that are context specific. The researcher gains a deep understanding of both the substance or content of issues and the underlying processes with which practitioners are involved. The researcher, in a sense develops a deep, even tacit understanding of the system and organisation under study (Patel et al., 2015). Being involved with the daily functions of an organisation one begins to understand the logics of the organisation, participants and systems under study. Such an understanding, based on a rich personal account, was necessary for the research themes and enquiries of this study, which required an understanding of how participants (City officials) construct, reproduce and modify socio-technical

systems (City electricity system) with particular attention to interpretation and negotiation of rules, organisational conditions and values (both personal and institutional).

Second, in my experience, the role of a researcher, in all likelihood, enabled greater access to data and high-level discussions and policy processes than had I been a City staff member (full participant) on the one hand, or in a more conventional researcher role on the other. This is partly because there are considerable tensions amongst departments and individuals in the City. Being an active, rather than full, participant, allowed movement between departments and built credibility and trust on the basis that I did not fully adopt 'the insider view' of my 'host' department, the Environmental Resource Management Department. Also, carrying the title 'researcher' often meant that officials across the administration were interested in talking to me about issues and complexities that they would not usually share with other officials. This in turn may enhance the credibility and quality of data collected.

Third, working in an embedded space provided an opportunity to triangulate and 'ground truth' facts and data (Patel et al., 2015). This was a form of boundary management whereby researchers and practitioners 'work together to develop data and information, analyse facts and forecasts and develop common assumptions' (Susskind et al. 1999: 376). This also involved 'feeding back' the research findings to practitioners in order to facilitate a process of co-producing its meaning to theoretical and practical problems (Van Buuren and Edelnbos, 2004).

Finally, it is necessary to briefly outline the value of knowledge co-production for the overall aim of this study. This thesis in general seeks to understand and explore a complex socio-technical system, in a unique context. Knowledge co-production is well suited for this, as it shares many underlying sensibilities with the dynamic systems theory and hence the MLP. Systems theory avoids reductionism and is guided by a set of holistic concepts that views the world as comprised of interacting systems that are integrated in different ways to produce the immense complexity 'in the world of experience' (Walby, 2007). Knowledge co-production similarly focuses on non-linear, complex and interconnected problems (Anderson et al., 2013). Moreover, systems theory acknowledges that complex systems do not operate in isolation but are coupled with 'neighbouring systems'. Although the lens of analysis becomes the system, individuals and institutions exert agency that affects the system in complex ways. Knowledge co-production is likewise a means to examine and collect data on the ways in which individuals or participants and organisations (the City) exert agency, which impacts on the whole system (electricity regime).

### 3.1.4. Grounded Theory and socio-technical systems

This study employed a range of methodological principles stemming from Grounded Theory (GT) to guide data collection and analysis. There are several reasons why a grounded approach is well suited to both investigations of socio-technical systems in general and the research questions of this study in particular. First, Shove and Walker (2007) argue that the MLP should employ methodologies and approaches that ensure greater rigour. GT provides such a rigorous, deep and systematic method of analysis. Bryant (2002) argues that socio-technical research is compatible with, even dependent upon, a grounded approach to improve its relevance and robustness.

Second, using principles of GT a researcher is able to interpret complex phenomena (Charmaz, 2006) that exhibit high degrees of emergence (Strauss and Corbin, 1998). Socio-technical systems are complex and emergent in nature. A proper understanding of socio-technical systems thus requires consideration of coupled, interlocked and nested systems and themes. A grounded approach provides researchers with such thick descriptions of complexity and emergence (Bryant, 2002).

Third, GT accommodates social issues and is sensitive to socially constructed experiences (Charmaz, 2006; Goulding, 1998). In particular to this study, such an approach is necessary for exploring the social dimensions of the socio-technical system under study and the ways in which actors within and outside the City construct, produce and reproduce the City's electricity regime.

Four, a central critique of the MLP is its bias towards Global North conditions in explaining socio-technical systems and change. In this regard Fernández and Lehnmanm (2005) highlight that a grounded approach is valuable when interrogating bias and assumptions in existing theoretical frameworks, specifically in relation to research of a socio-technical nature. Moreover, GT places much emphasis on grounding an account in empirical observations and data (Martin and Turner, 1986) and the importance of context for theory. This context-sensitivity is apt for the Global South context of this study, where the relevance of the analytical constructs of the MLP to Global South has been questioned. Thus, a grounded approach encourages an exploration of contextual, Global South conditions, and the implications these have on the MLP.

There is considerable debate in literature and schools of thought related to GT. It is thus necessary to outline the approach adopted in this study. Three main versions of GT can be identified, the Glaserian version, the Straussian version and the constructivist version pioneered by Charmaz's (2006). The main difference between Glaserian and Straussian GT relates to the way in which primary research is undertaken, with the Glaserian version advocating for a more flexible approach compared to the more prescriptive Straussian approach. Later, Charmaz (2006) argued that

categories and theories do not emerge from the data, but are constructed by the researcher through an interaction with the data. This introduced a social construction version of GT that acknowledges the researcher's positionality. Charmaz (1990) argues that the researcher creates an organisation and presentation of the data after interacting with it, rather than discovering order within the data.

This research is conducted within a more reflexive and social constructionist approach to GT, as it takes the position that all observations are made from a particular perspective. As Dey (1999: 104) argues, 'even if we accept the (doubtful) proposition that categories are discovered, what we discover will depend in some degree on what we are looking for'. During the research process I thus acknowledged that my own assumptions and expectations partly shaped data analysis and collection and the overall research process. Thus, I followed recommendations by Pidgeon and Henwood (1997) that researchers should document research carefully and continuously reflect on biases, assumptions, values and interpretations of context. The former was done mainly through ongoing reflection in a research journal. In brief, I adopted a tempered social construction position for this research that is cognisant that a 'bird's eye' view of reality is not possible.

Importantly, the research was guided by a grounded approach in two fundamental ways. First, I followed an iterative process between collecting data, coding, data analysis and theory development<sup>18</sup>. This meant a continuous process of testing concepts in the field and reformulation of theory based on data. Second, in fieldwork, within an embedded and participatory role, City officials were regarded as co-analysts in co-producing knowledge and theory.

### 3.2. Data collection techniques

During periods of fieldwork, data was collected through a range of techniques. The use of several data collection techniques was important for developing a more rich and holistic understanding (Lincoln and Denzin, 1994) of the socio-technical system under study. Using mixed data collection techniques was also valuable for purposes of triangulation (Mayoux, 2001) and completeness (Greene et al., 1989). In describing data collection methods for investigating complex socio-technical systems, Baxter and Sommerville (2011) outline the need for collecting and merging both technical data with social and organisational data. Observations, interviews, documents and surveys are mentioned as important methods for collecting data on the social dimensions of socio-technical systems (ibid). Furthermore, knowledge co-production, participant observation and grounded theory (Charmaz, 2006) are all compatible with a wide range of data collection techniques

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<sup>18</sup> See Section 3.3



including interviews (structured and semi-structured), ethnographic observations, keeping a field journal (for both observations and theory development) and documents.

### 3.2.1. Ethnographic observations

As discussed above, the research questions of this study motivated spending a significant amount of time embedded in the City to gain an in-depth understanding of its electricity (socio-technical) system; the socio-economic, regulatory and organisational elements of this system; and plans and actions aimed at reconfiguring this system.

During periods of embedded research I participated in over 100 meetings and workshops including participation in weekly Energy and Climate Change Unit Meetings, monthly Energy and Climate Change Portfolio Committee Meetings and a large number of ad-hoc, issue-based meetings related to various urban energy and climate change projects and policy. The participants in different meetings and meeting categories varied substantially. Thus, across all workshops and meetings, I was able to collect and record observations from a broad range of participants including officials across departments, City councillors, NGOs, research institutions, funding organisations, international partnership organisations, umbrella organisations and private sector associations and firms. I recorded and transcribed full minutes of many of these meetings and workshops. The full list of meetings and workshops participated in during periods of fieldwork is provided in Section 1.1 of Appendix 1.

In the first period of embedded research (seven months) I was less discerning about which meetings and workshops I participated in. However, in the final period of embedded research (seven months) I tried to be far more selective; and attempted to limit participation to meetings and workshops of particular relevance to my research questions. This approach is in line with GT, which encourages initially spreading ‘the net of discovery’ wide (Charmaz 2006). After themes and sub-themes start emerging, it then becomes necessary to prioritise data collection and analysis according to these emerging themes.

Apart from formal meetings, informal discussions and engagements were also considerably valuable; particularly in terms of triangulation and ‘reality testing’. Overall, during the periods of embeddedness a substantial amount of data was gathered through unstructured or ethnographic observations. All ethnographic observations were collected and recorded in a field journal. Information on the participants, the setting of the observation, the context and the content discussed (Atkinson and Hammersley, 1994) was included in recorded observations. In all field notes and entries I differentiated between verbatim records, summaries and interpretations (Adler

and Adler, 1994). In most cases field notes were made immediately after an observation. This field journal of observations was read and analysed<sup>19</sup> throughout the duration of the study.

Authors outline several limitations of ethnographic observations, particularly related to bias and validity of observational data. In my research, I used both triangulation and reflexivity as a means to reduce these risks. Specifically, observations were triangulated with data from documents, informal conversations, meetings and interviews (Babbie and Mouton, 2001). Further, throughout the period of fieldwork I sought to monitor and reflect on my own influence and perceptions and the impact I may have had on the social context (Dey, 1999). This is described in more detail below<sup>20</sup>.

### 3.2.2. Interviews

A series of semi-structured, structured and informal interviews were conducted with relevant participants involved in the City's electricity system (regime) and sustainable energy projects and policy (reconfigurations). A total of 25 interviews were conducted. These are listed in Appendix 1. The average length of interviews was approximately 30 minutes. Interviews were regarded as a relevant data collection technique due to the complex nature of the City's electricity system, the heterogeneity in views and perceptions of participants, and the nature of the research enquiries, which required an understanding of the social construction of the electricity system. Notably, interviews were necessary to understand the ways in which: participants perceive the role of the City in sustainable reconfigurations; participants interpret rules (regulation) and perceive barriers to sustainable energy transitions; and organisational cultures and structures of relevant department's impact on sustainable transitions. Interviews also facilitated a deeper understanding of the technical constraints related to reconfiguration of the City's electricity regime. The extent and type of information required from various stakeholders varied greatly and accordingly the structure of the interviews differed (Mayoux, 2001).

Officials in the following departments were interviewed: Electricity Department, Supply Chain Management Department; Budget Department, Environmental Resource Management Department (ERMD); Transport Department; Spatial Planning and Urban Design Department; Planning and Building Development Management Department; and Economic Development Department. The participants in these departments were chosen as these departments are assigned responsibility for a project, programme or initiative under the ECAP; each are involved, to varying degrees, in the functioning of the City's electricity system and hence potential transition

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<sup>19</sup> See Section 3.3

<sup>20</sup> See Section 3.4

initiatives; and they each hold mandates that have implications for the City's electricity system. A small number of interviews were conducted with participants from NGOs, the private sector and academia. This was deemed necessary in order to gain an understanding of the position, views, involvement and role of different external social groupings in relation to City's electricity system and transition potentials.

Interviewed officials were mainly senior professionals, managers and unit heads. At the stage of research design, it was hoped that more interviews with Executive Directors (ED) and Directors could be conducted as it was expected that EDs and Directors would have the most intimate knowledge and experience of the City's functioning, the City electricity system and conditions and constraints to sustainable change. This proved very difficult and often directors referred interview requests to their relevant unit heads. As such, alternate means were used to ascertain the views, positions and rationalities of relevant Executive Directors and Directors. In particular, I attended Executive Management Team Meetings, Portfolio Committees and Energy and Climate Change Committee meetings in which relevant EDs and directors were in attendance. In certain instances, external workshops and conferences were attended and data transcribed where relevant Directors and EDs presented on topics of importance for this study. However, mid-way through the study, having already spent significant time in the City, it was decided that interviews with unit heads, managers and senior professionals would suffice in respect of the research questions of this study. This decision was largely due to a realisation that 'middle management' predominantly drive projects, have considerable knowledge of municipal processes, regulation and structures, are far more involved with the technical aspects of infrastructure-related programmes and operations and make weighty decisions, which are then 'pushed upwards' through EDs.

At the beginning of the period of fieldwork informal and open-ended interviews were conducted. These provided an initial understanding and insights in relation to the themes of this thesis. It also provided a deeper understanding of the personal experience, values and perspectives (Mayoux, 2003) of participants. Later in the period of embeddedness, more focused and specific information was required. Accordingly, a number of interviews of a more semi-structured nature were conducted. Where regarded as appropriate, interviews were recorded. In some instances, it was felt that recording an interview would negatively impact on trust. Interviews considered particularly significant, vis-à-vis the research questions and themes of this study, were fully transcribed. In instances where interviews were not recorded, detailed notes were taken. In particular, notes were recorded of quotes and statements that highlighted or emphasised an insight of importance to the themes and research questions of this study as well as the broad content discussed. As with

observations, notes from interviews differentiated between verbatim records, summaries and interpretations.

Only one Councillor, the City's political stratum, was interviewed in this study. This is a potential omission or gap in data collection; as later in the research process it was realised that politicians play a fundamental role in influencing, constraining and enabling energy transition plans, policy and projects. Conversely, there are two justifications for why interviews with Councillors were deemed unnecessary. First, the impact of local politics on the City's energy transition is a peripheral focus as part of the organisational theme. Nevertheless, it was realised that politics has an indirect bearing on all the themes of this study, as well as energy transitions in general. Thus it was necessary to gain some understanding of the political context. Such data and understanding were gained through alternate means including documents and observations. Communications and interactions between officials and politicians and between politicians and the public were observed and recorded in Portfolio Committees, media statements and public engagements. Further, due to the participatory nature of the research, I participated in workshops with Councillors in the Energy Committee and had informal discussions and contact with a number of politicians. These interactions helped me to partly understand, although admittedly on a superficial level, the background and rationale of political decisions and their associated impacts on sustainability transitions.

### 3.2.3. Documents

Collecting and analysing documents was necessary for two reasons. First, it was initially necessary to analyse documents in order to gain a broad understanding of, *inter alia*, the City's organisational structures, the current configuration of the electricity system, interactions and arrangements between national government and the City, and the City's formal engagement with energy transition processes, including objectives, projects, and plans related to reconfiguring its electricity system. Second, at a later stage of 'embedded' research documentation was used as a backdrop to guide interviews and observations. Documents were for instance used to understand; the specific projects that interviewees were involved with and associated issues and challenges with implementation; the ways in which individuals and departments interpret and follow organisational and regulatory rules in day-to-day operations; and their perspectives and positions on specific transition agendas or projects.

Documents collected and analysed included City by-laws, policies, strategies and plans; reports to Portfolio Committees, Mayco or Council; operating procedures, memorandums and directives; minutes of meetings; and copies of e-mail correspondence and PowerPoint presentations.

Secondary research of relevance such as commissioned reports, journal articles and book chapters related to sustainable transitions in Cape Town were further collected and analysed. A full list of primary and secondary sources is included in the reference list. Although a large volume of these documents were available on the City's intranet, ERMDs archives and library, the City's website and other publicly accessible online databases, in many cases it was necessary to track them down and request copies from an official involved in drafting specific reports.

Notably, in order to navigate the regulatory theme of this study, a thorough collection and analysis of regulation and legal instruments was necessary. This analysis sought to gain clarity on the regulatory instruments to which the City is bound, its mandate and legislated competencies in managing socio-technical change, its regulatory-making authority, track-record in implementation of energy transition initiatives and the ways in which these rules are interpreted and given meaning in practice. In brief it was necessary to gain in-depth knowledge of the regulatory environment in which the City operates and to which it is bound.

Initially, a wide scan and quick analysis was undertaken to understand the particular regulatory and legal instruments that relate to the City's electricity system and reconfiguration plans. This was followed with an in-depth reading and analysis of relevant Acts of Parliament, regulations, standards and guidelines. In general, three categories of relevant regulation were collected and analysed, namely; electricity regulations, municipal regulations and other regulations that impact on municipal energy issues. A full list of legal instruments analysed is provided in the reference list.

The regulatory analysis was followed with several detailed interviews with officials engaged with the City's electricity system and sustainable energy initiatives. Officials were interviewed about interpretation and implementation of regulation, regulatory 'barriers' to implementation and approaches to unblocking barriers. During the limited interviews with private sector participants, questions were raised in order to understand the ways in which regulatory instruments inhibit or support 'niche' innovation.

#### 3.2.4. Quantitative data

This study made use of a large volume of quantitative data. Numerical data was used predominantly for descriptive purposes and to gain a better understanding of the City's electricity system. There are several arguments for using quantitative data in qualitative research, particularly in relation to complex systems (Bryman, 2006). First, with a complex socio-technical system such as the City's electricity system, it is apparent that building a proper empirical model of the systems function and structure is improved by collecting quantitative data. Almalki (2016) argues that quantitative-based heuristic models are important for gaining a proper understanding of socio-technical systems. The

use of quantitative data alongside qualitative research has been employed in a number of socio-technical studies (Berkhout et al., 2009; and Thiam et al., 2012). The rationale for collecting quantitative data in this study relates to the notion of completeness. Greene et al. (1989) holds that the use of quantitative data in qualitative research can facilitate a more complete account of the area of investigation. This was regarded as particularly important to create an accurate representation of the electricity system and to properly identify trends, patterns and changes in the system.

An additional rationale for using quantitative data was triangulation, in that qualitative and quantitative data may corroborate or correspond with one another (Deacon et al., 1998). It was felt that quantitative data related to the City's electricity system would be complimentary and could elaborate, enhance or illustrate results or themes that emerged during field work (Almalki, 2016). It was thus felt that it could enhance the integrity of the findings (Greene et al., 1989), extend the depth of enquiry (Bryman, 2006) or generate unexpected results (Johnson and Onwuegbuzie, 2004).

For the purposes of the research questions it was considered necessary to collect several quantitative data sets. This included data related to the electricity revenue model of the City, Cape Town's electricity consumption trends, budget expenditure breakdowns for electricity-related services, departmental operational expenditure, figures on bulk purchases of electricity from Eskom, sector-based electricity demand, data on cross-subsidisation between electricity user categories and uptake of energy efficiency and small scale embedded generation (SSEG) across Cape Town. Accordingly, raw data was collected from a number of sources, including the City's SAP system, data from distribution intake points, annual budgets, Electricity Department annual reports and published City tariffs. Although much of this numerical data was available from existing documents and through the City's intranet, in other cases I requested datasets from officials, mainly in the Electricity Department or ERMD and from external parties such as Sustainable Energy Africa or the Energy Research Centre both of which had been involved in research related to the City's energy and electricity system.

This data was used to populate multiple Excel spreadsheets, which were constantly added to throughout the period of fieldwork. As highlighted, this numerical data was used mainly for descriptive purposes and to gain a fuller description of the City's electricity system. Thus, graphs, charts and tables were developed in order to better understand, corroborate and illustrate the themes that were emerging from fieldwork.

### 3.3. Organising data and analysis

This study employed several data analysis techniques and processes stemming from GT and ethnography. Overall, the process of data analysis included coding (open, selective and theoretical), categorising emerging themes, comparative and narrative analysis and integrating emerging themes. Although GT is not prescriptive in the research process, it does provide guidelines for identifying and integrating categories of ‘meaning from the data’, and ways to establish links and relationships between categories.

Importantly, grounded approaches combine the process of data collection and analysis, whereby the researcher moves continuously between collection and analysis in order to ground the analysis in the data. During periods of embeddedness, shortly after data was collected through interviews, observations and documents, I undertook coding. Backman and Kyngäs (1999) argue that the simultaneous and parallel process of data collection and coding is important, as it allows a structured discovery of data that reveals emerging themes and potential areas of enquiry. Initially, open coding was used, which involved reading and re-reading data and attaching descriptive labels to separate instances of a phenomenon. In coding I attempted to attach descriptive category labels that stemmed from the data itself (*in vivo*) i.e. using words or phrases from participants in the study. This was to some extent to prevent imposing pre-existing concepts onto the analysis (Melia, 1996) and to gain a description of the City’s electricity regime and transition potentials from the perspective of participants themselves.

This process involved immersion in descriptive data that I had collected. Overall, this initial coding and analysis process allowed themes, patterns and similarities to emerge across different sources of data. These were in essence emerging sub-themes within the four broad themes of this study<sup>21</sup>. Coding was not done line-by-line but rather sentence-by-sentence and paragraph-by-paragraph. Meila (1996) recommends line-by-line coding, as the smaller the unit of analysis the more themes emerge. However, due to the sheer volume of data from periods of field work, this was not feasible.

Throughout coding, both narrative analysis and comparative analysis was used. Narrative analysis specifically required reflection on ‘the ways in which stories are told within an organisation’ and the ways in which participants are organised within groups (Moezzi et al., 2017: 3). This was particularly reflected upon in relation to data from interviews and observations from different departments in the City. Further, data from interviews, observations and documents, data related to separate issues or sub-units and data from different stakeholder groups were compared throughout the coding process. This was undertaken to determine patterns and dissimilarities

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<sup>21</sup> Regulation, geographical context (Global South), scale (urban) and organisations

between data and to compare these with emerging themes in order to determine whether the data confirmed or refuted these themes. Comparisons are important as it allows constant identification of similarities and differences between emerging themes and the identification of sub-themes (Dey, 1999). This, in turn, ensures recognition and capture of complexity and diversity in data. Further, negative cases<sup>22</sup> were identified and reflected upon. This process of negative case analysis is intended to facilitate qualification and elaboration of the emerging themes.

Throughout these processes<sup>23</sup> I reflected on the emerging themes in a research journal. This journal was a written record of reflections, analysis and interactions with theory and was intended to reflect on both the research process and substantive findings. The journal traced emerging themes, justifications of descriptive labels, relationships and linkages between categories, integration of higher and lower-level categories and reflections on the research questions and research direction.

This process of immersion and interacting with the data provided me with an opportunity to reflect on and prioritise further data collection. This process is referred to as theoretical sampling. In brief, it involved collecting further data on the basis of themes that emerged during earlier stages of data analysis. It further enables one to reality-check emerging themes against new data collected in the field. Data collection decisions were thus refined according to initial descriptive themes that emerged. This process enabled a movement from a descriptive level to an analytic level, referred to as theoretical sensitivity.

Following subsequent data collection, selective coding was undertaken. This stage allowed me to filter and code data deemed more relevant to the emerging themes. The key messages or themes of data from interviews, observations and documents were thus selected and coded. This process facilitated the identification and integration of lower-level (descriptive) themes into higher level (analytic units) themes. It involved interpreting rather than simply describing instances of a phenomenon. The process of interpreting themes is important, as it allowed me to become aware of the links and relationships between and amongst themes and helped to arrange these themes in a meaningful way. Comparisons and reflections in my journal were also done in this process. In brief, selective coding facilitated the discovery and identification of analytic themes. Thus, several analytic themes were identified within the four broad themes of this study. These are presented in the Table 3.1. These broadly correlate with the manner in which the substantive chapters (Chapter 5 - 8) are organised.

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<sup>22</sup> i.e. data that did not fit within emerging categories

<sup>23</sup> Open-coding, comparative analysis and identification of negative analysis



Table 3.1: Themes and categories emerging from coding

Main themes	Context (Global South)	Scale (urban)	Regulation	Organisation
Analytic Sub-themes	Poverty and access	Constraints to urban transitions	Barriers and constraints	Organisational functions
	Inequality and differentiation in relation to infrastructure	Securitisation, marginalisation and bounding	Tensions between national and local government	Organisational structure and cultures
	Cross-subsidy systems	National cross-subsidy systems	Impacts of top-down regulation on sub-systems	Risk, compliance and innovation
	Resource constraints and competition	Implications of urban autonomy	Divergent interpretations	Decision-making, policy and politics
Core theme	Contested values (environment & development)	Contested values (urban & national securities)	Contested values in regulation	Contested values in organisations

Through analysis of documents, interviews and observations it became evident that most participants in the study expressed some notion or concern related to values and contestation underpinning the reproduction and reconfiguration of the City's electricity regime. Notably, participants placed importance on a wide range of contested values related to, *inter alia*, equity, environmental sustainability, climate change, poverty alleviation and redistribution. This cut across most of the emerging sub-themes. This to some extent was regarded as a core theme.

Once this core theme began to emerge, data collection and analysis became more focused on this core theme (regime values). Interviews and observations were thus focused on further exploration of this theme. This was a shorter period of data collection as it appeared that by and large no new sub-themes could be identified from additional data. This was an indication that theoretical saturation had been reached, where dense themes had emerged. Although it is always possible to refine and add to these themes through new data, theoretical saturation is a practical signal to end field work.

Finally, I undertook the last stage of coding referred to as theoretical coding in order to develop the conceptual contributions of this study. In this process, the core theme and sub-themes of this study were sorted, reflected upon and cross referenced with literature. Through theoretical coding, I reflected upon the emergent themes and sought to develop the conceptual relationships between

themes and their relevance (Melia, 1996) to transitions in general and the MLP in particular. Theoretical codes assisted in recognising patterns and linkages and supported the process of theorising on the ways in which sustainable transitions are constrained or supported by values, scale, regulatory systems, organisational conditions and policy contexts. In this way, theoretical coding was a process of knitting fractured themes together in order to provide a broader picture. This process of theoretical coding further ensured consistency and objectivity in my analysis (Strauss and Corbin, 1998).

This three-stage process of open-ended coding, selective coding and theoretical coding more or less coincided with the three-year period of embeddedness. In the first year of embeddedness I cast a wide net on the data collected and coded according to descriptive themes. In the second year I was able to be more selective in data collection and coding was undertaken with a focus more on higher-level analysis. In the final year coding was far more focused on the core theme that cut across data collection and the implications for the MLP and sustainable transition theory.

### 3.4. Reflexivity and ethical considerations

Knowledge co-production raises several issues related to ethics, positionality and insider-outsider views. Notably, engaged scholarship potentially creates risks of co-option and doubts over objectivity (Greyling *et al.*, 2016; Polk, 2015; Pieterse, 2014). In particular, an embedded researcher may adopt insider views or internalise the established position or assumptive worlds of the organisation in which they are embedded (Greyling *et al.*, 2016; Soal, 2012) or have an absence of distance to ensure a critical viewpoint (Atkinson and Hammersley, 1994). As raised by Pieterse, this is 'clearly a risky position to take: it raises all manner of methodological alarm bells and opens the door for accusations of political capture' (2014:19).

However, this problem is not unique and is similar to the challenges posed by participant observation and ethnographic studies in general. Two strategies were used to reduce these risks, namely, distancing and reflexivity. Distancing is highly recommended in embedded, participatory or engaged research. This does not mean adopting a position of detached distance, but rather recognising your role within incumbent power structures, and from such a viewpoint seeking to understand the case in a renewed light. Foucault (1972) argues that it is impossible for participants to see the discourse they employed and were subjected to without a period of separation. Indeed, the Knowledge Transfer Programme was structured to facilitate such distance and reflective space. As mentioned, the research period was split, where I was 'embedded' for seven months in the City undertaking applied research and thereafter given five months to concentrate solely on research. This split was repeated over three years. Thus, during my three years of embeddedness, I spent

sufficiently long periods outside of the field, which gave me an opportunity to reflect (Leigh, 2014). This mimicked and indeed formalised methodological strategies in ethnographic studies of 'distancing' and 'moving in and out of the field' to enable reflection on bias and subjectivity (Soal, 2014). Rather than a static position of 'insider', my experience was an oscillation between insider and outsider (Wolgemuth et al., 2015).

Secondly, throughout the research I strived towards reflexivity in perspective and approach (Enguix, 2014; Eppley, 2006). Reflexivity is increasingly viewed as a necessary perspective of qualitative research (Kumsa et al., 2014). Specifically, Genus and Coles (2008) argue that researching socio-technical systems requires seeing oneself and one's work within wider contexts, particularly where the researcher is in close proximity to the system being researched. Reflexivity requires researchers to focus on self-knowledge and sensitivity; better understand the role of the self in the creation of knowledge; making explicit the political commitments and contexts of research practice and carefully self-monitor the impact of their biases, beliefs, and personal experiences on their research (Leigh, 2014). This is an on-going process of critical self-evaluation and internal dialogue related to bias, subjectivity and positionality (May, 2010). This positionality relates to, amongst other factors, personal experience, race, class, beliefs, biases, preferences and political and ideological attitudes. Berger says:

Reflexivity is situating the researcher as non-exploitative and compassionate toward the research subjects, thus helping to address concerns regarding negative effects of power in researcher–researched relationships. Reflexivity helps maintain the ethics of the relationship between researcher and research by 'decolonizing' the discourse of the 'other' (2013: 3).

In my experience, the main factors in my position that required constant reflexivity included biases, personal experiences and political and ideological attitudes. In particular, prior to commencing my fieldwork, I was an intern in the Energy and Climate Change Unit. This previous experience is problematic for grounded research, as Glaser and Strauss (1967) suggest that researchers should enter the field without preconceived notions of the area of enquiry or of what may be discovered. However, counter arguments have been made that prior knowledge and experience of an area is often unavoidable (Charmaz, 2006; Dey, 1999). Nevertheless, it is still important to unpack biases stemming from this previous knowledge and experience that may have influenced my observations, interpretation and understanding. Notably, my past experience meant I came from a particular position, chiefly the desire to see a sustainable energy transition realised. Ideologically, I would consider myself an environmentalist. This meant reflexive bias and knee-jerk emotional responses to participants which did not share these sensibilities. This required constant reflection in order to ensure credible, trustworthy, compassionate and non-exploitative research.

Next, it is necessary to reflect on the risks of being embedded in a single organisation and the implications this has for co-option and risks of adopting 'insider views'. There are two reasons why this was not problematic for this study. First, an organisation such as the City is large. It is a heterogeneous organisation, made up of a multitude of individuals, organisational cultures, rationalities, motives and beliefs. On a day-to-day basis I engaged with a wide range of different departments and individuals with varied and sometimes completely oppositional views and opinions. This, in a sense, provided a check and balance against adopting the views of a single organisation, individual or department. Contact with a multiplicity of actors with different agendas and rationalities provided a means for triangulation as well as a means for reflecting on my bias (Leigh, 2014; Atkinson and Hammersley, 1994). Second, it could be argued that there is in fact value in being embedded in a single organisation in understanding a socio-technical system. Such an approach moves away from an account of an external perception of an organisation and rather to see the organisation under study as one with its own constructed and bounded rationalities. This allows the researcher to see an organisation and its participants on its own terms and to understand the internal logics of its policy, decision-making and actions.

A final ethical issue relates to information. In an embedded position, I had access to potentially sensitive and confidential discussions and interactions. Being deeply embedded in an organisation, officials began to assume that I was part of the City and it would have been impractical to repeatedly state and re-state that I was in an embedded research position. This would severely disrupt the research process, trust and credibility. This brings up ethical considerations related to confidentiality, consent and uncertainties on the data that can be used. Tensions of 'exposing' or critiquing City policy and practices are similarly raised. This was a difficult balancing act between giving an honest account of my experience and to limit exposure and risk to the City.

### 3.5. Conclusion

The above methodological strategy was designed in order to explore the themes and research questions of this thesis. It thus translated the conceptual aims of this study into a methodology capable of properly addressing the research questions within practical constraints. An investigation into a complex socio-technical system, with the aim of exploring a Global South context with unique variables, alongside enquiries related to scale, regulation and organisations required a mixed or multiple research strategy. Notably, a case study provided a site to explore and highlight key variables related to the themes of this study. Using the City of Cape Town as a case provided rich and deep data and insights on the conditions and implications of sustainable energy transitions in a Global South context (outlier case); organisational conditions within a government entity that is

highly involved in the reproduction of a socio-technical regime; the relationship between regulation and regime stability and change from the perspective of an implementing agent; and the tensions between local and national transitions from the viewpoint of a local government.

Participant observation and knowledge co-production in particular were suited for an exploration of a socio-technical system in a unique context. In fact, the basis of knowledge co-production is facilitation of spaces to research complex, real world dilemmas. Being in an embedded position enabled the collection of rich data on and insights into the City's electricity system. It provided an ideal platform to map actors and networks involved in the socio-technical system and to gain proper insights into the values, rules, agendas, cultures and conditions that either constrain or enable socio-technical change. Moreover, the value of knowledge co-production in building trust and credibility, facilitating access to multiple sources of quality data, and creating opportunities to triangulate and 'reality check' concepts cannot be overstated. Furthermore, the principles of knowledge co-production aligned neatly to the grounded approach employed in research. Both stress the value of regarding participants as co-generators of knowledge. This is important for investigating themes that are complex and interdisciplinary in nature, where practitioners offer a deep, grounded and tacit knowledge that may enrich a researcher's understanding of a socio-technical system.

Lastly, the research questions and themes necessitated collecting data from multiple sources and employing multiple collection techniques including documents, quantitative data, observations and interviews. In view of the complex nature of socio-technical systems, such an approach allows the researcher to develop a relatively full and rich model and understanding of the system under study.

## Chapter 4: Context - energy and electricity in the City of Cape Town

### 4.1. Introduction

This chapter seeks to provide an introduction to the case study, the City's electricity system. It provides a brief background and context to its electricity system in relation to scale (urban), regulation, organisational and energy poverty and inequality as exemplars of conditions particular to cities in the Global South. It is first, however, necessary to briefly outline Cape Town's energy profile and challenges.

### 4.2. Energy trends and challenges in Cape Town

Cape Town confronts a multitude of connected challenges related to its energy system. These include a comparatively high carbon footprint (CCT, 2011c); increasing energy insecurity related to reliability of supply (SEA, 2013a); rising costs of energy (CCT, 2010b); pervasive energy poverty and inequality, including lack of access to basic energy services (Ea Energy Analyses, 2007; SEA, 2014a); and urban sprawl with associated high transport emissions (CCT, 2012a).

In South Africa 85% of electricity consumed is generated through burning coal.<sup>24</sup> Cape Town is reliant on the national grid for its electricity. According to the City's State of Energy Report (CCT, 2011c), Cape Town's total annual energy consumption is around 128 million GJ<sup>25</sup>, approximately 5% of South Africa's total energy demand. The city's total annual carbon footprint is approximately 7.8 tonnes of CO<sup>2</sup> equivalent per capita. This is comparable to mega-cities such as New York, with ten times Cape Town's gross domestic product and excessive when compared to developing cities with similar GDPs (CCT, 2015a).

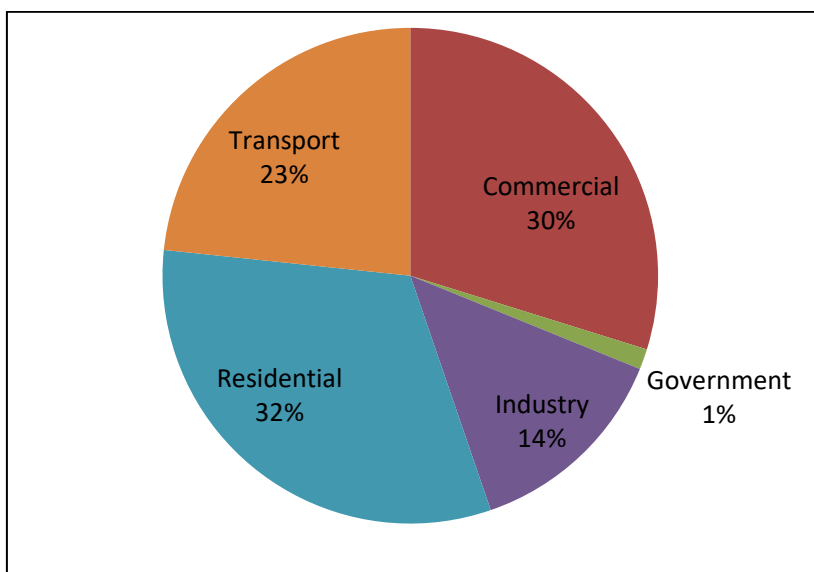
Cape Town's electricity consumption accounts for 64% of its carbon footprint. As shown in Figure 4.1 residential and commercial sectors are jointly responsible for the largest share of emissions, together accounting for approximately 62% of the city's total emissions.

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<sup>24</sup> Coal is highly carbon and water intensive with 2.4 tonnes of CO<sup>2</sup> emitted per tonne of coal.

<sup>25</sup> Based on 2007 data

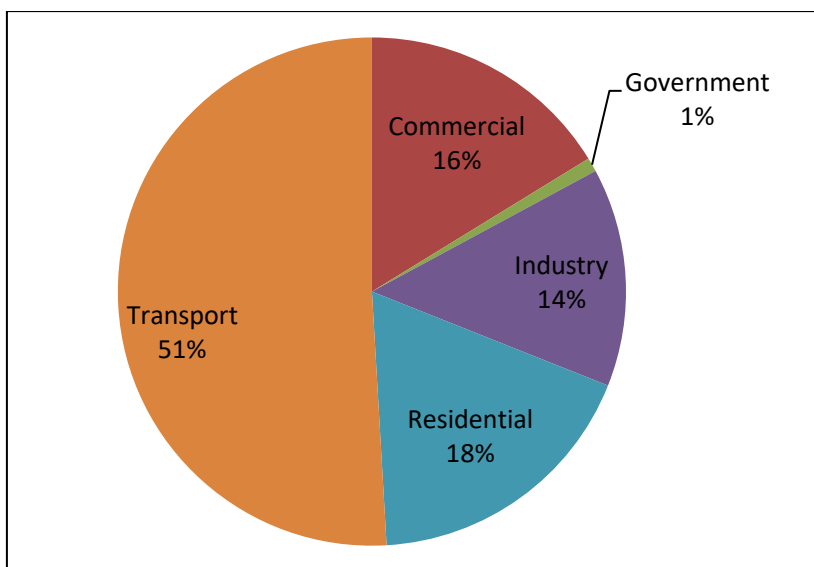
*Figure 4.1: Cape Town carbon emissions by sector (2007)*



Source: City of Cape Town (2011c)

The residential and commercial sectors, together, account for 83% of electricity consumption in Cape Town (CCT, 2011c). It is worth noting that although the transport sector consumes 51% of Cape Town's energy (Figure 4.2.); it is responsible for only 23% of total emissions (Figure 4.1).

*Figure 4.2: Cape Town energy consumption by sector (2007)*

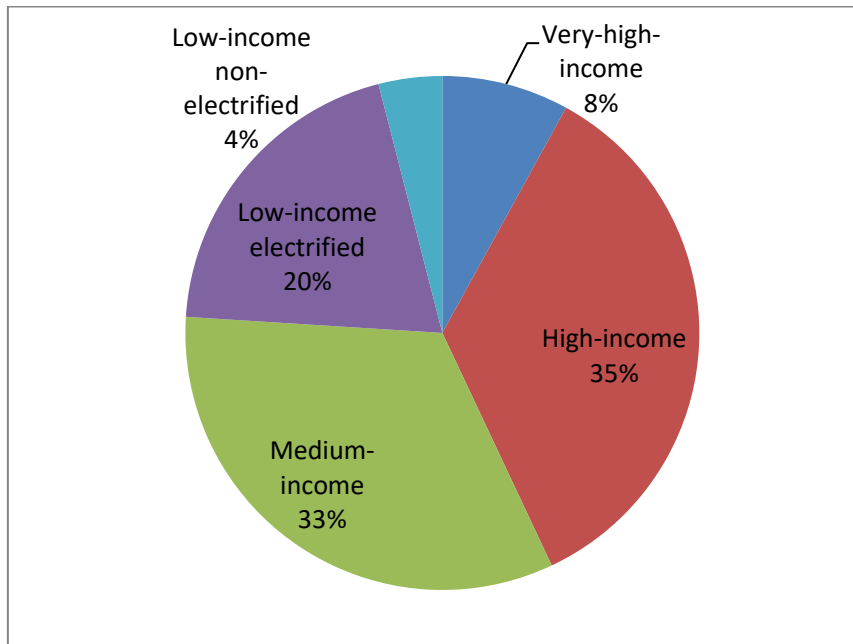


Source: City of Cape Town (2011c)

The city's residential sector predominantly uses electricity as a fuel source. Paraffin, liquid petroleum gas (LPG) and wood are also used, although predominantly in lower-income households. Low-income households, which make up 44% of households, contribute only 24% of total residential energy use. Conversely, high-income and very high-income households, which make up

only 24% of total households use 43% of all residential energy (Figure 4.3). Thus, the amount and types of energy consumed by households vary according to income level. This is indicative of Cape Town's intense energy inequality, where many households and communities live in energy poverty with limited access to basic energy services, whilst high-end residential users consume significant proportions of Cape Town's total energy (CCT, 2015a).

*Figure 4.3: Cape Town residential energy consumption by income level (2007)*



Source: City of Cape Town (2011c)

The commercial sector accounts for 16% of energy consumption and is responsible for 28% of total carbon emissions. As with the residential sector, the commercial sector's dependency on coal-based electricity (96% of commercial energy use) accounts for its high carbon intensity. The city's industrial sector share of energy consumption (14%) is considerably smaller than the rest of South Africa<sup>26</sup>. This is due to the fact that the city's economy is less dependent on primary sectors and largely driven by the tertiary sector. Local government accounts for only 1% of total energy consumed in the city<sup>27</sup>. However, the City, as a single organisation, is the single largest user of energy (CCT, 2011c).

Cape Town's electricity consumption increased steadily between 2001 and 2009, corresponding to the city's population growth, reaching a high of approximately 12 250 GWh in 2009 (CCT, 2012f). Per capita electricity consumption also increased between 2001 and 2007, peaking at

<sup>26</sup> Up to 41% in some regions

<sup>27</sup> and 1% of carbon emissions



approximately 3 430 kWh in 2007. However, a decline in electricity consumption, both total and per capita, was recorded in both 2010 and 2011 by approximately 0.6% each year (CCT, 2015a).

#### 4.3. City of Cape Town transition commitments

The City has put in place a number of policies, plans and strategies to address energy and climate mitigation challenges including the Integrated Municipal Environmental Policy (CCT, 2003a) and Energy and Climate Change Strategy (CCT, 2006d). The establishment of these policies and plans were complex and contested processes, which were driven and opposed by a diverse set of actors. The conditions surrounding, and actors involved in, these policy processes are discussed in more depth in Chapter 6.

Notably, in 2010 the City developed the ECAP, its principal energy and climate change plan. The ECAP includes 40 programme areas, made up of over 120 projects that are co-ordinated by an Energy and Climate Change Unit. Responsibilities for projects and programmes cut across directorates and departments (CCT, 2010a). More than any other formal City document, the ECAP highlights the City's intentions in relation to reconfiguring its electricity system. It converts the City's energy transition commitments into concrete plans and projects.<sup>28</sup> It is thus necessary, in the following chapters, to properly identify and engage with the way in which the ECAP constructs and conceptualises a sustainable energy transition, its origins and protagonists, the actors that influenced its formal adoption by Council and contestation in these processes.

In 2011 the City commissioned an Optimum Energy Futures (OEF) study. The main purpose of the study was to use data of current energy consumption, growth rates and trends to forecast future energy consumption and carbon intensity of various trajectories<sup>29</sup>. The study outlined various scenarios to determine the effect of various energy-related interventions in Cape Town (CCT, 2011a). Further, in 2015 the City developed a 'Cape Town Energy 2040' vision for a sustainable energy future (CCT, 2015c).

#### 4.4. Energy poverty in Cape Town

The City has in place a number of programmes, policies and plans to address energy poverty, including electrification of low-income housing, increasing free basic electricity allocations and roll-out of energy services, such as solar water heaters and ceilings in low-income housing (CCT, 2012a). Despite such policies and programmes energy poverty stubbornly subsists in Cape Town (SEA, 2010). In Cape Town energy poverty is most prevalent in informal settlements. The City reports that

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<sup>28</sup> The ECAP was later revised as the Updated Sustainable Energy Plan (2016)

<sup>29</sup> Up until 2050

up to 24% of the metropolises' population live in desperate need of a dwelling of an adequate standard (CCT, 2012a). Although the City has a policy to electrify informal settlements this excludes electrification for informal settlements on private land and areas under servitude. In practice, up to 25% of informal settlements do not qualify for electrification and serious backlogs prevent 'qualifying' informal settlements from receiving connections (CCT, 2012a).

Due to lack of access to electricity residents of informal settlements frequently connect illegally to the grid through the use of unsafe extension cord style electricity connections. This practice, brought on by desperation, results in a significant number of electrocutions and deaths every year (SEA, 2010; SEA, 2014a). Even with access to electricity, many low-income households in Cape Town still use paraffin for cooking as electricity is regarded as too expensive. Paraffin-related injuries include poisoning of children, respiratory diseases and burns (SEA, 2014a). Further, the use of paraffin for cooking and candles for lighting cause frequent shack fires in Cape Town resulting in death, injury and loss of property (Ea Energy Analysis, 2007).

#### 4.5. Energy regulation and mandates

Municipalities are creatures of statute and accordingly are regulated by a suite of legal instruments including the Constitution of the Republic of South Africa (Constitution), 1996, Municipal Structures Act, 1998, Municipal Systems Act, 2000, Municipal Finance Management Act, 2003 and Municipal Fiscal Powers and Functions Act, 2003. Importantly, municipalities have electricity distribution rights and functions that are entrenched in the Constitution, outlined in the Electricity Regulation Act, 2006 and regulated through a suite of codes, standards and regulations.

Recently, a host of regulations have been introduced that provide municipalities with a limited mandate over energy efficiency and renewable energy. The Electricity Regulations for Compulsory norms and Standards for Reticulation Services (Compulsory Norms and Standards) (DME, 2008b) outline a number of mandatory energy efficiency measures that municipalities must undertake including installation of efficient lighting in all municipal buildings, street lights and traffic lights; the installation of smart meters and time-of-use pricing for large users and the installation of devices to facilitate ripple control. The National Energy Efficiency Strategy (DOE, 2013) provides funding, administered through the Division of Revenue Act, 2012 for municipal energy efficiency and demand side management. These include street and traffic light retrofits, installation of energy efficient water pumps and building retrofits. The Standard Conditions (NERSA, 2011a) requires municipalities to facilitate small-scale embedded generation within their distribution area. The regulation includes directives on the tariff structure for exporting onto the grid, reporting and safety requirements. Further, the National Building Regulations and Building Standards Act, as amended

by Part XA: Energy Usage in Buildings, 2011 requires municipalities to enforce a range of energy efficient building standards.

Notably, in respect of renewable electricity supply the Electricity Regulations on New Generation Capacity (DOE, 2011d) established a Single Buyers Office, which specifies that only Eskom can buy and sell electricity. This places a limitation on the capacity of municipalities to enter into power purchase agreements with an independent power producer or to generate electricity from municipal operations.

Finally, the Municipal Systems Act, 2000 provides that municipalities have the authority to adopt and implement electricity tariffs that reflect a number of principles including equity, proportionality, free basic electricity provision, cost reflectivity and efficient use of resources.

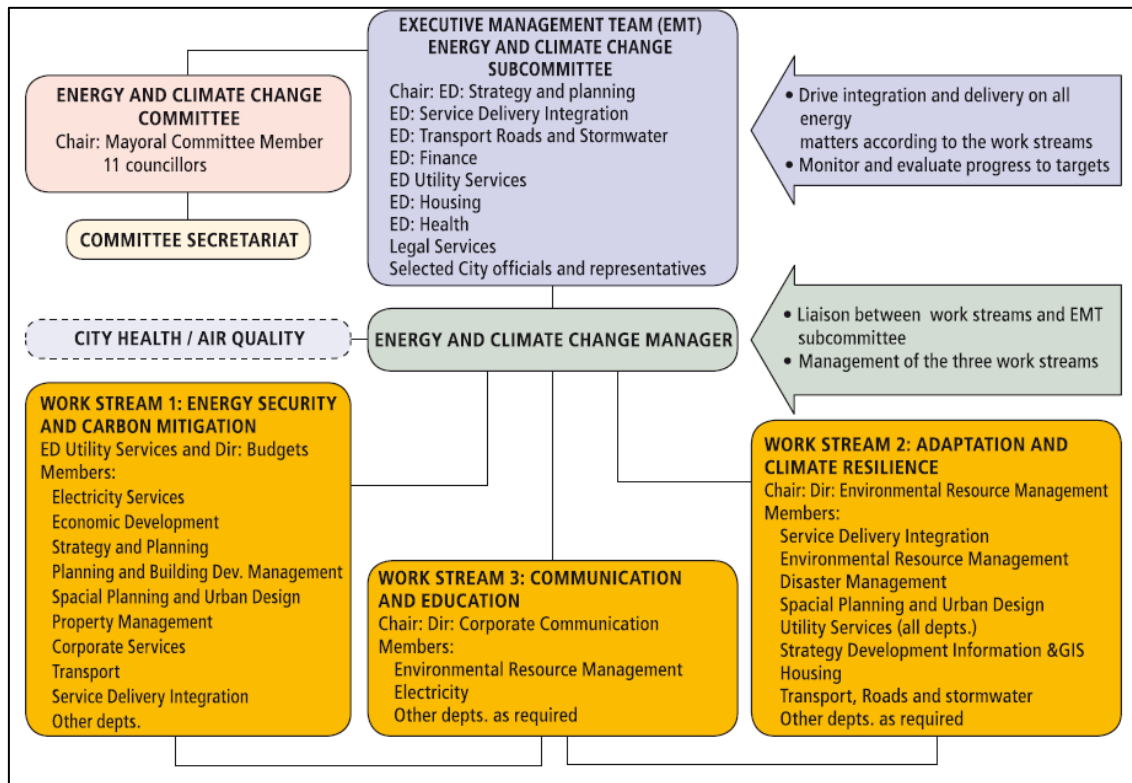
#### 4.6. Organisations and energy transitions in Cape Town

There are a diverse range of organisational actors that focus on urban energy and climate change matters in Cape Town, both within the City and across Cape Town. Importantly, in 2010 the City established a number of dedicated structures to coordinate energy and climate actions across the municipality. These include the establishment of a political structure (Energy and Climate Change Committee), an administrative structure (EMT Subcommittee on Energy and Climate Change<sup>30</sup>) made up of senior management and three administrative work streams related to energy and climate mitigation (Figure 4.4). Further, it established an Energy and Climate Change Unit within the Environmental Resource Management Department that coordinates implementation of the ECAP (CCT, 2011b; CCT, 2015a).

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<sup>30</sup> Later restructured as a Green Economy Working Group

Figure 4.4: City of Cape Town institutional structure for energy and climate change



Source: City of Cape Town (2011)

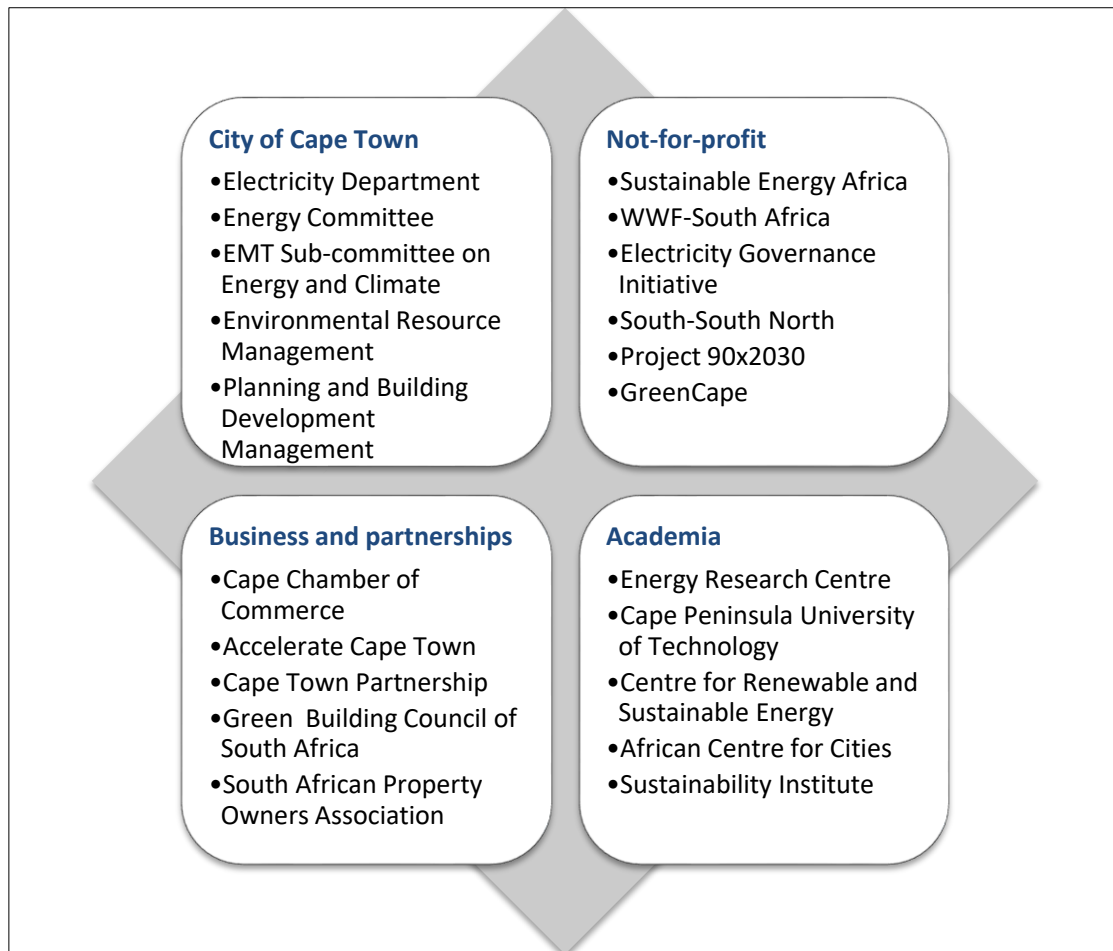
Moreover, the City participates in a number of national and international energy and climate-related platforms, reporting bodies and partnership programmes including; the Mexico City Pact, Carbonn Cities Climate Registry, the Carbon Disclosure Project, C40 Cities Network and the Clinton Climate Initiative (CCT, 2015b). The City further participates and shares knowledge in a range of national platforms including South African Cities Network, South African Local Government Association, Association of Municipal Electricity Undertakings and the Cities Energy Support Unit (SACN, 2013; SALGA, 2013a; SEA, 2015; CCT, 2011b).

Cape Town is also home to several not-for-profit and research institutions (Figure 4.5) with a high degree of expertise and experience in sustainable energy development including Sustainable Energy Africa, GreenCape, Electricity Governance Initiative, Project 90x2030, South-South-North and WWF-SA<sup>31</sup> and the Energy Research Centre and the Centre for Renewable and Sustainable Energy<sup>32</sup> (GreenCape, 2012). Thus, a complex and vibrant set of organisations and organisational conditions exist in Cape Town, in which to investigate the organisational theme of this study.

<sup>31</sup> Not-for-profit organisations

<sup>32</sup> Research institutions

*Figure 4.5: Key Cape Town-based organisations engaged in reconfiguration of City of Cape Town's electricity regime*



#### 4.7. Conclusion

This chapter provided a brief outline of the case study, the City's electricity system, correlated to the themes and research questions of this study. This served two purposes. First, it further develops the rationale for selecting the City of Cape Town as a case. As is evident, the City provides fertile ground to explore the four themes of this study, as unique variables, features and manifestations of the gaps identified in literature are present and strongly represented in the City. Second, this chapter provides some context and background to guide the results of this study, presented in the following four chapters.

## Chapter 5: Regimes and values in the Global South

### 5.1. Introduction

The aim of this chapter is to assess the implications of applying an STS framework to cities in the Global South through engaging with two intersecting themes; scale (urban) and context (Global South). At the outset, this chapter examines the ‘specificities’ (Silver and Marvin, 2016) of urban transitions in the Global South with particular attention to socio-economic, institutional and spatial-scalar conditions and reflects on the conceptual implications of these to the MLP. Socio-economic considerations are explored through identifying manifestations of energy poverty, informality and inequality in Cape Town. These are considered conditions, related to energy infrastructure, that are unique or at least pronounced in urban Global South contexts. The presence of institutional conditions such as centralised, state-owned monopolies and restrictions on competition are identified and explored as exemplars of the Global South. Further, the relationship between centralised networks, municipal systems and urban transitions are explored through interrogating the way in which the City’s electricity regime is structured, its sub-systems and linkages to the national electricity regime.

Second, this chapter tests and further explores the implicit bias towards privatisation and deregulation that underpin transition studies. This is contrasted with notions of the public good (Monstadt, 2009; Pieterse, 2008) and development (Eberhard, 2010; Jaglin, 2014) functions that underpin socio-technical networks. This theme is empirically engaged with through identifying the ways in which development objectives and public goods are integrated into the City’s electricity regime. This leads to a conceptualisation of socio-technical regimes as systems of values and social contracts.

Third, this chapter examines contestation in socio-technical regimes and transitions (Genus and Coles, 2008) and the manifestation of such conflict in Global South contexts (Lawhon and Murphy, 2011). These themes are empirically tested through identifying tensions in the City’s electricity regime that are both systemic as well as contestation in transition policy. Notably, tensions between developmental and environmental agendas are discussed. This further guides an examination of the ways in which transitions are framed and contributes to debate on definitions of sustainable transitions and the beneficiaries of transitions.

Four, this chapter explores themes of best practice and ecological modernism common in STS research and broader sustainability governance and policy. Notably, it deliberates on the green and technical bias that stems from the Global North origins of STS research. These themes are tested

through contrasting two projects that are driven by different policy agendas: namely net-metering to facilitate distributed energy and electrification of informal settlements. These examples are used to highlight the practical and conceptual contradictions of applying a STS framework in diverse socio-economic contexts.

Finally, this chapter interrogates the urban resource securitisation narrative common in urban transition analysis and examines the ‘spatially patchy’ progress in transitions (Coenen and Truffer, 2012) in the context of a developmental state with nationally-bounded infrastructure policy priorities. These themes are interrogated through examining plans, programmes and projects led by a specific ‘social grouping’ within the City and a broader network of actors related to energy autonomy in general and municipal energy supply in particular. This further contributes to debates on the scalar dimensions of transitions (Rohracher and Späth, 2009), tensions between national and urban transitions and the relationship between cities and the ‘landscape-regime-niche’ hierarchy (Smith, 2007a; and Graham and Marvin, 2001).

## 5.2. Results

### 5.2.1. The regime: The City of Cape Town’s electricity distribution system

This section discusses broad socio-economic, institutional and spatial-scalar features of the City’s current electricity regime that may potentially be regarded as exemplars of electricity regimes in the Global South. Cape Town confronts significant equity challenges related to electricity infrastructure. The City provides a high standard of electricity reticulation and associated services to an affluent formal residential, commercial and industrial sector. Conversely, many poor households and communities lack access to even basic energy services (SEA, 2014a). According to the City’s Integrated Development Plan (CCT, 2012) 50 704 households or 5.62% of total households in Cape Town do not have electricity supply. This is compounded by increasing urbanisation (SEA, 2014a; SEA, 2013b).

Access to energy services and the types of services available are thus highly unequal in Cape Town. Such inequities persist from colonial and apartheid legacies of intense infrastructure exclusion and marginalisation (SEA, 2013b). This infrastructure marginalisation causes a host of negative social impacts. Notably, low-income households use mixed or hybrid fuel sources, such as paraffin, candles and biomass, even if formal electricity connections are available. The use of paraffin and candles, in particular, result in respiratory diseases and shack fires. A report commissioned by the City highlights that the ‘use of paraffin is without doubt the most serious safety concern for low income households’ and that ‘the number of people that are killed or injured by paraffin runs into many thousands of incidents every year’ (Ea Energy Analyses, 2007: 15). Lack of access to electricity

moreover drives poor households to construct illegal electricity connections that often result in electrocutions. Further, inadequate energy services such as insulation cause a range of health problems or worsen existing ailments (SEA, 2014). As energy is a large driver of socio-economic development (Winkler, 2010) inadequate access in already impoverished communities further exacerbates poverty.

Energy poverty is widespread in Cape Town. Examples of energy poverty include: no access to electricity, extension cord-type of connection to electricity which is unsafe, expensive and unreliable; use of paraffin for cooking which is highly unsafe and overspending on electricity (Ea Energy Analyses, 2007:1).

Second, there are complex, nested institutional factors present in relation to the City's electricity regime. In South Africa the electricity sector is a regulated monopoly. There is limited competition in supply, as Eskom is legally entrenched as the 'Single Buyer and Seller' of electricity. Although attempts have been made to introduce an Independent Market and Systems Operator<sup>33</sup>, these have failed as a result of resistance from Eskom (Eberhard, 2010). Further, transmission, generation and distribution, to a large extent, is bundled<sup>34</sup> and controlled by Eskom. These national level institutional features frame and bound the City's electricity configuration. Further, there is a relatively limited role for the private sector in the City's distribution grid and a corresponding scarcity of energy-related innovation firms in Cape Town. This is due to the fact that the City is not able to generate or enter into contracts for renewable power and the existence of long-term contracts with suppliers for metering and maintenance (CCT, 2010f). In addition, the City's electricity infrastructure is dilapidated and ageing. This is emphasised in the Electricity Department Business Plan (CCT, 2011f), which estimates a backlog for refurbishment and maintenance of infrastructure of approximately R1.6 billion

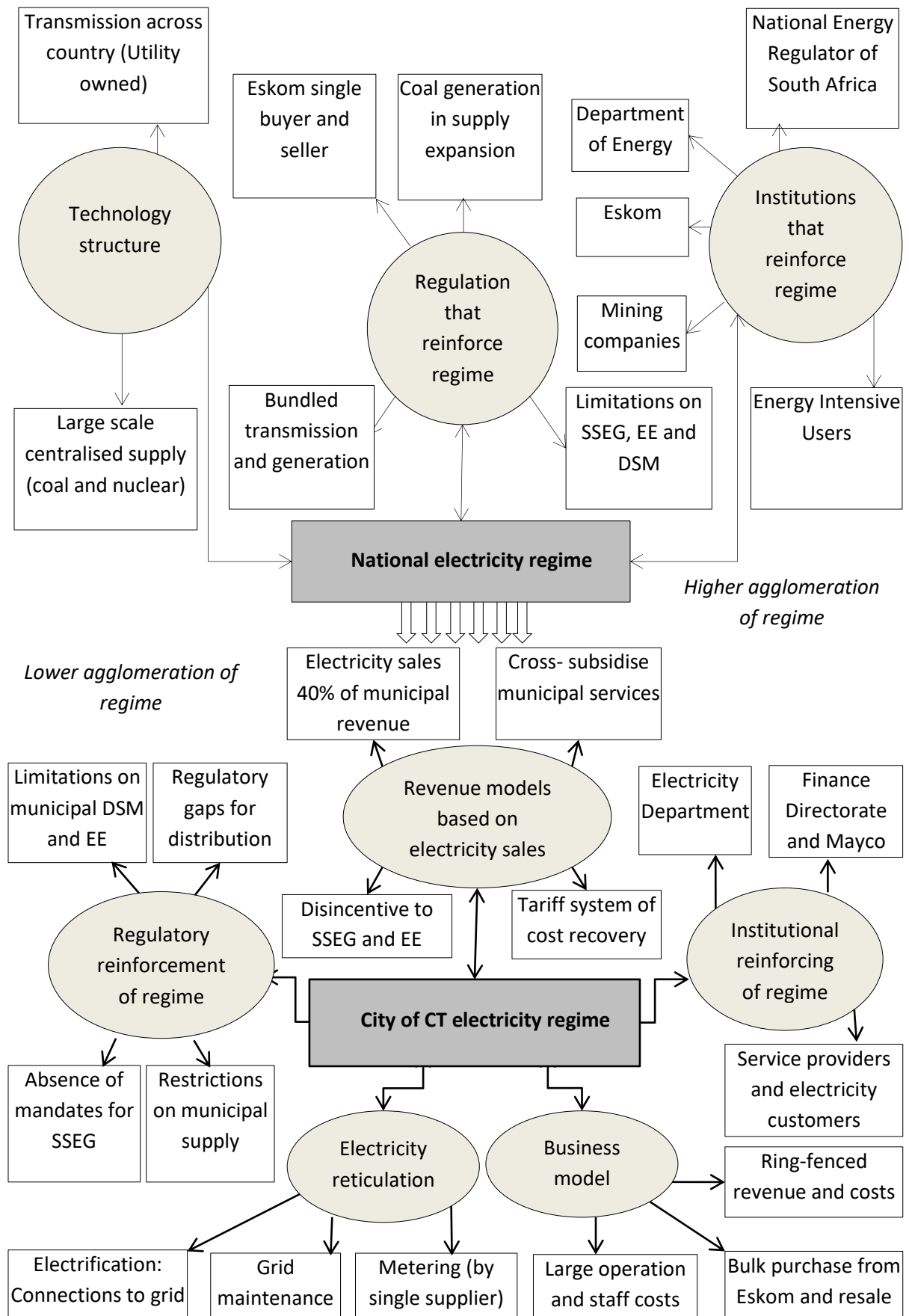
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<sup>33</sup> An Independent Market and Systems Operator would facilitate competition and enable multiple, specifically renewable energy, generators to sell electricity to more than one buyer.

<sup>34</sup> This refers to an arrangement whereby electricity generation, transmission, and distribution, as well as ancillary and retail services, are provided by one entity.

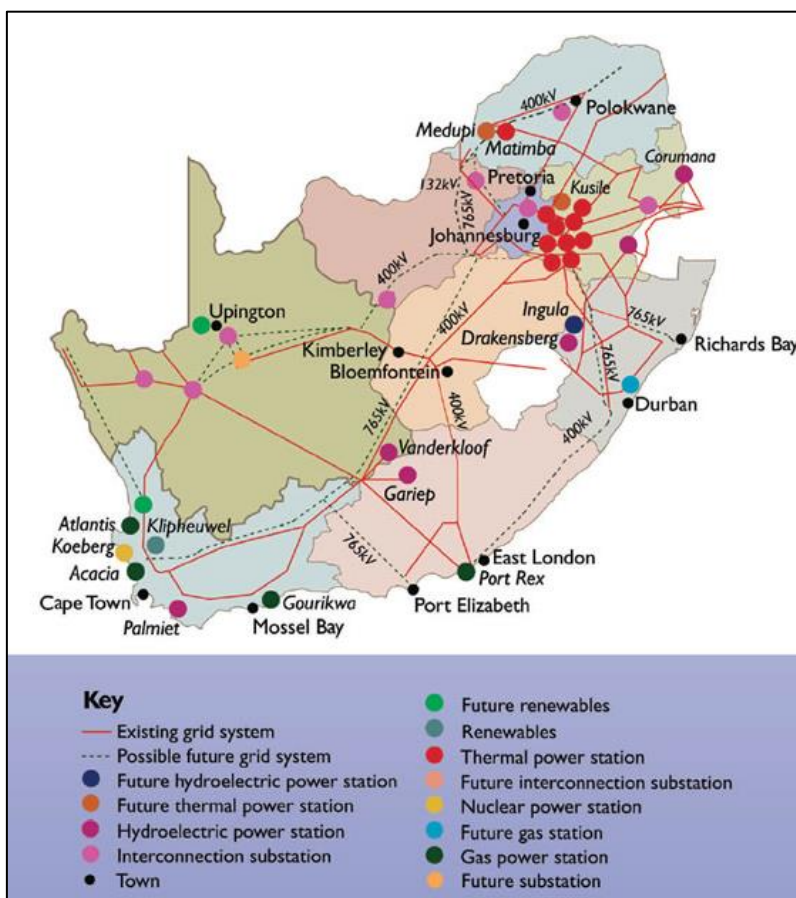


Figure 5.1: Diagrammatic representation of City of Cape Town's electricity regime



Third, there are a number of spatial-scalar specificities present in the City that provides insight into the relationship between regimes and cities in the Global South. In South Africa, electricity is transmitted across long distances from the source of generation<sup>35</sup> to the end users in cities (SACN, 2006; SEA, 2013a). This brings to the fore spatial externalities and inequalities whereby the health and negative socio-economic impacts of coal generation are felt far from areas of consumption. Further, as a result, Cape Town is predominantly reliant on centralised coal-fired power generated more than 1 600 kilometres away (Figure 5.2). Thus, the City is essentially locked into a carbon-intensive electricity regime.

Figure 5.2: South African grid map, indicating power and transmission network



Source: Eskom (2011)

In general, the City's electricity regime may be conceptualised as a lower agglomeration of the national electricity regime. The business model of the City's electricity utility is to buy electricity in bulk from Eskom and resell it to customers with a surcharge levelled (CCT, 2012b)<sup>36</sup>. This generates revenue that finances general electricity services and operations including electrification, grid

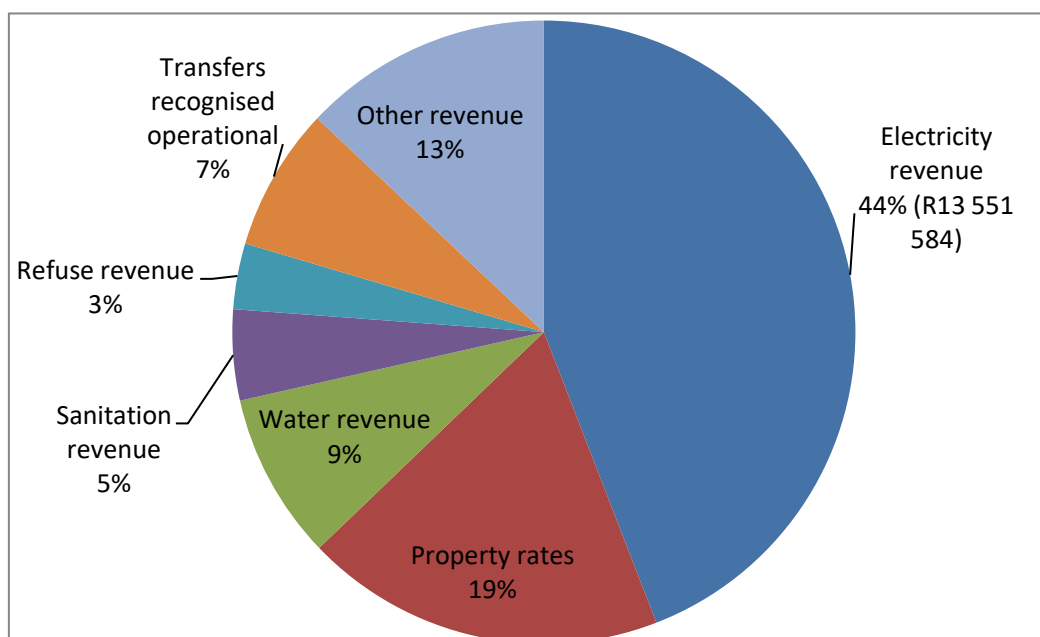
<sup>35</sup> Mainly Mpumalanga

<sup>36</sup> This is represented in Figure 5.1.

maintenance, metering installation and infrastructure roll-out (CCT, 2011f). Notably, the City uses the operating surplus of electricity sales to cross-subsidise general municipal services<sup>37</sup>. This arrangement is provided for in the Municipal Finance Management Act, 2003 which requires municipalities to ensure that electricity tariffs ‘generate an operating surplus for financing of general services’. Thus, the national electricity regime is highly entangled with not only municipal electricity regimes, but also the entire function and structure of municipalities, particularly related to service delivery.

In order to gauge the extent of this entanglement and the degree to which operating surpluses finance general services, data provided by the Electricity Department was analysed. As indicated in Figure 5.3 in 2014/2015 electricity revenue contributed approximately R13.5 billion or 44% of total revenue.

*Figure 5.3: Revenue contributions by source (2014/2015)*



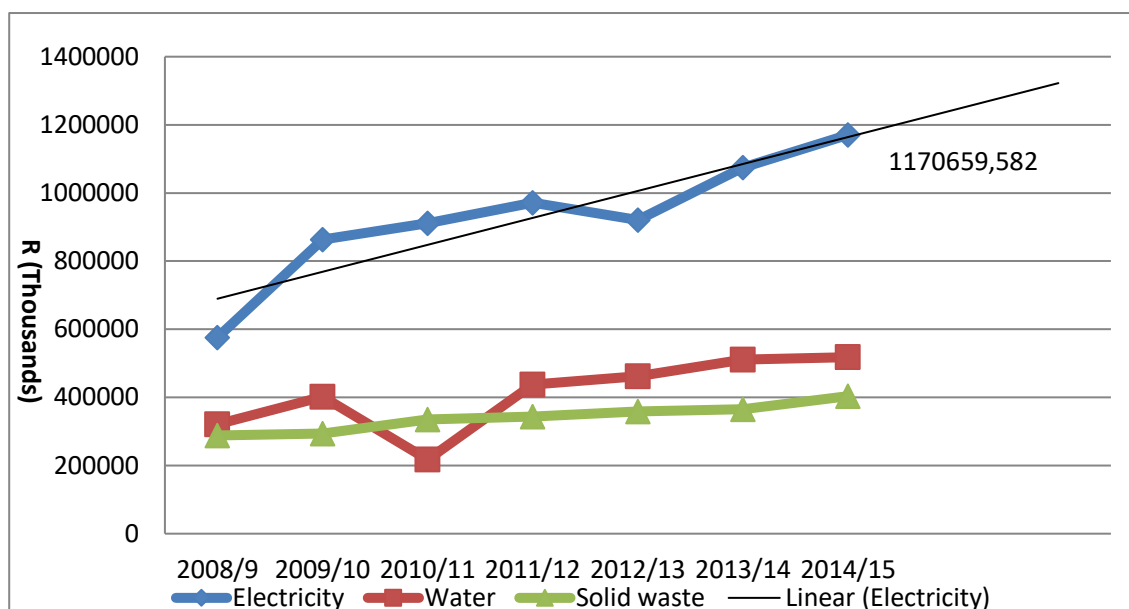
Source: Raw data from Electricity Department (2013) and City of Cape Town Budget (2008-2015)

The total operating surplus of electricity transferred directly into the City fiscus amounts to approximately R1.17 billion annually (Figure 5.4). It is clear that the contribution of electricity sales to general services is high and set to increase to R2 billion according to the City’s MTREF (CCT, 2012b). Thus, the municipal electricity regime and its accompanying revenue model are built upon the need to increase electricity consumption in order to maintain the integrity of the system. This both emulates and is inter-connected with the underlying logics of the national regime, which

<sup>37</sup> Represented in Figure 5.1.

depends on sales from municipalities and energy intensive users to finance the entire national grid. Thus, the City's electricity regime, and, moreover, the overall municipal structure and function may thus be regarded as both an extension and a reinforcing agent of these logics<sup>38</sup>.

Figure 5.4: Operating surplus (deficit) of different utility services



Source: Raw data from City of Cape Town Budget (2008/09-2014/15)

Electricity revenue is raised through tariffs that are highly regulated by NERSA and require adherence to a range of principles<sup>39</sup> including financial sustainability and cross-subsidisation (CCT, 2007a; DME, 2004). In summary, the City's electricity regime is made up of a range of sub-systems that are enmeshed with the national socio-technical regime. These include an incumbent business and revenue model, physical infrastructure, operational structures, electricity and broader municipal service delivery, cross-subsidy systems, tariff structures and an administrative system<sup>40</sup>. These subsystems are represented in Figure 5.1.

The institutions that reinforce the municipal electricity regime include Eskom, NERSA<sup>41</sup> and the Department of Energy<sup>42</sup>. As mentioned, Eskom depends on local electricity regimes to both distribute power to end-users and as a revenue stream. Bulk supply contracts entered into between Eskom and the City ensure that this historical arrangement persists. The Department of Energy, in formulating energy policy such as the Integrated Resource Plan (DOE, 2011e), repeatedly reproduce

<sup>38</sup> See Figure 5.1.

<sup>39</sup> See Table 10.2: Appendix 4 for an outline of Legally binding tariff principles in setting electricity tariffs

<sup>40</sup> The incumbent configuration is bolstered by a range of back-office systems, which support the regimes functions, including billing systems, the Systems Applications Products (SAP System) and data management structures (CCT, 2011f).

<sup>41</sup> Regulator

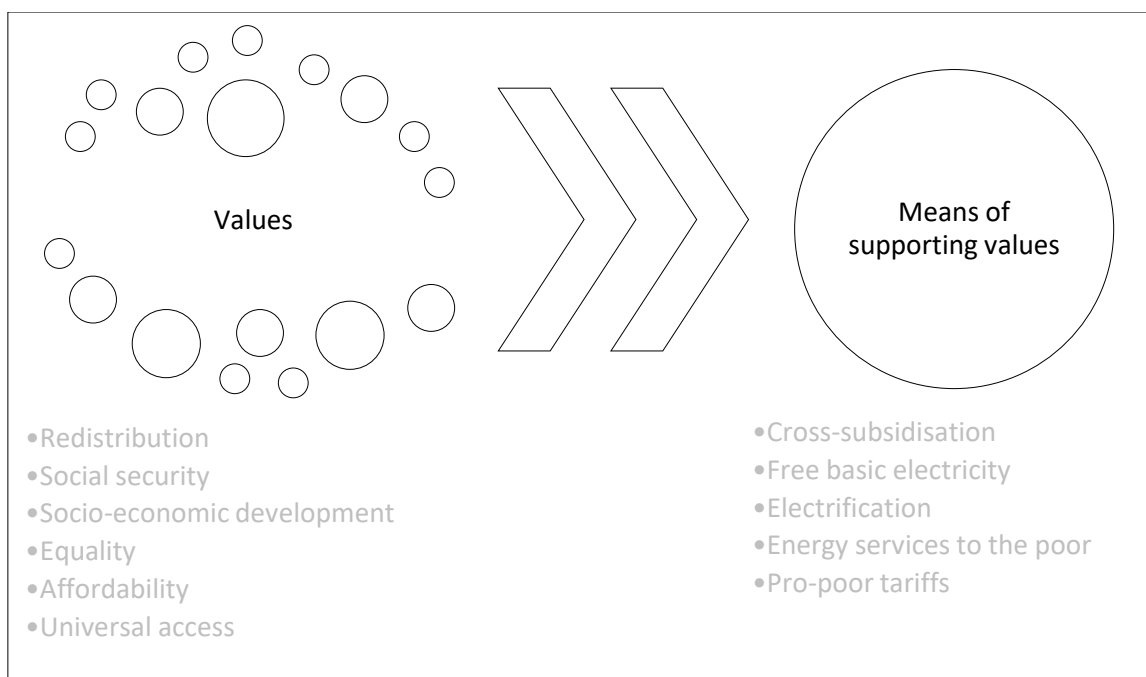
<sup>42</sup> Policy developer

a centralised, predominantly fossil-fuel based supply model (EGI, 2013). City customers accustomed to historically cheap and abundant electricity and suppliers of grid facilities, such as metering suppliers with long-term contracts, benefit from and thus reinforce the regime. Associations such as the Association of Municipal Electricity Undertakings (AMEU) further defend the business model of municipal electricity utilities through a range of mechanisms such as advocacy (AMEU, 2009; AMEU, 2011), participation in legal reform and in some instances litigation. The City's electricity regime is furthermore reinforced by a multitude of formal rules including legislation, energy and infrastructure policy and regulations<sup>43</sup>.

### 5.2.2. Values and the social contract of the incumbent electricity regime

In response to historical and enduring energy poverty and marginalisation, it is evident that the City's electricity regime has been configured to facilitate a wide set of development objectives, social principles and public goods. These are intended to redress apartheid infrastructure legacies (Eberhard, 2010). These are hereinafter referred to broadly as values. The values maintained by the municipal electricity regime include socio-economic development; equitable access to electricity and energy services; redistribution; affordable electricity provision; and social security for the urban poor. The ways in which these values are integrated into the City's electricity regime are discussed in turn.

*Figure 5.5: Developmental regime values underpinning City of Cape Town's electricity regime*

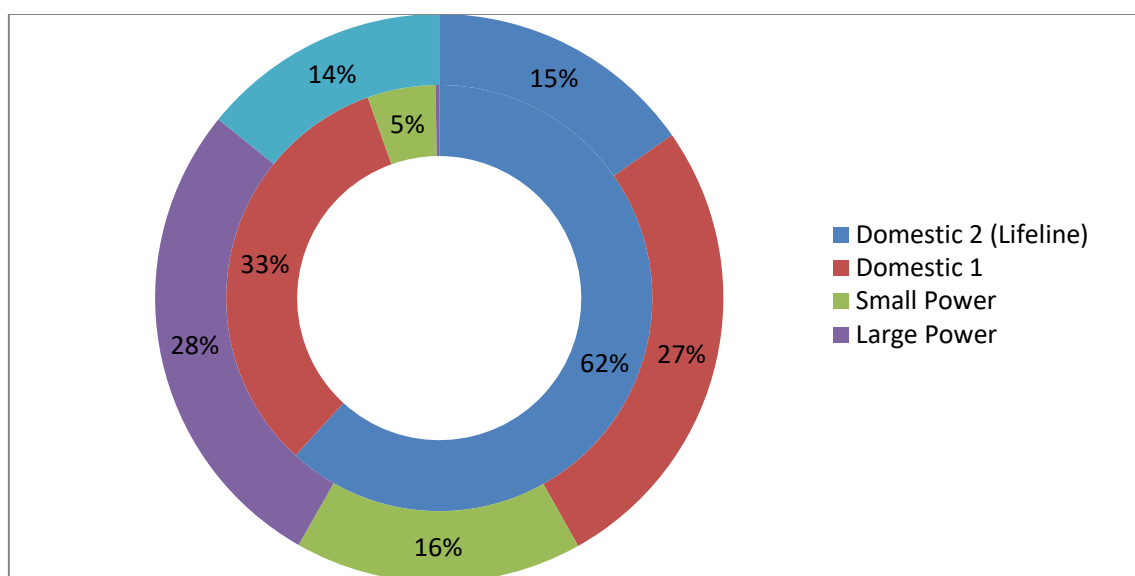


<sup>43</sup> This is comprehensively examined in Chapter 8.

There is considerable redistribution<sup>44</sup> built into the City's electricity regime. In terms to the Electricity Pricing Policy (Department of Minerals and Energy [DME], 2004e) the City is legally required to cross-subsidise the poor. However, it is necessary to understand the extent to which cross-subsidisation is central to the municipal electricity regime. An analysis of electricity sales data, provided by the Electricity Department, on the number of customers per tariff category compared to the contribution of those categories to revenue clearly reveals this. As highlighted by Figure 5.6, whilst middle and high income electricity customers <sup>45</sup> make up only 38% of total customers by number, they generate approximately 85% of the City's electricity revenue.

The forms of cross-subsidisation enabled through the electricity regime include substantial transfers between tariff categories<sup>46</sup>; electricity revenue supporting energy-based services for the poor, such as electrification of informal settlements (CCT 2012a); and electricity revenue cross-subsidising general municipal services. In relation to the latter, it is evident that the City's service delivery is generally targeted to the poor. The Integrated Development Plan (CCT, 2012a) indicates that up to 65% of the City's total budget is spent on low-income households.

*Figure 5.6: Electricity customer categories by number (inner ring) compared to contribution to sales (outer ring)*



Source: Raw data from Electricity Department SAP system (2012)

Second, the electricity regime facilitates affordable electricity for the poor. The City has established a four-block tariff in line with the Electricity Pricing Policy (DME, 2004) and Municipal Systems Act, 2000. The tariff is progressive and includes a Lifeline Tariff to support low-income households. During interviews the majority of participants in the Electricity Department stressed that

<sup>44</sup> Through cross-subsidisation

<sup>45</sup> Domestic 1 and Small, Large and Very Large Power

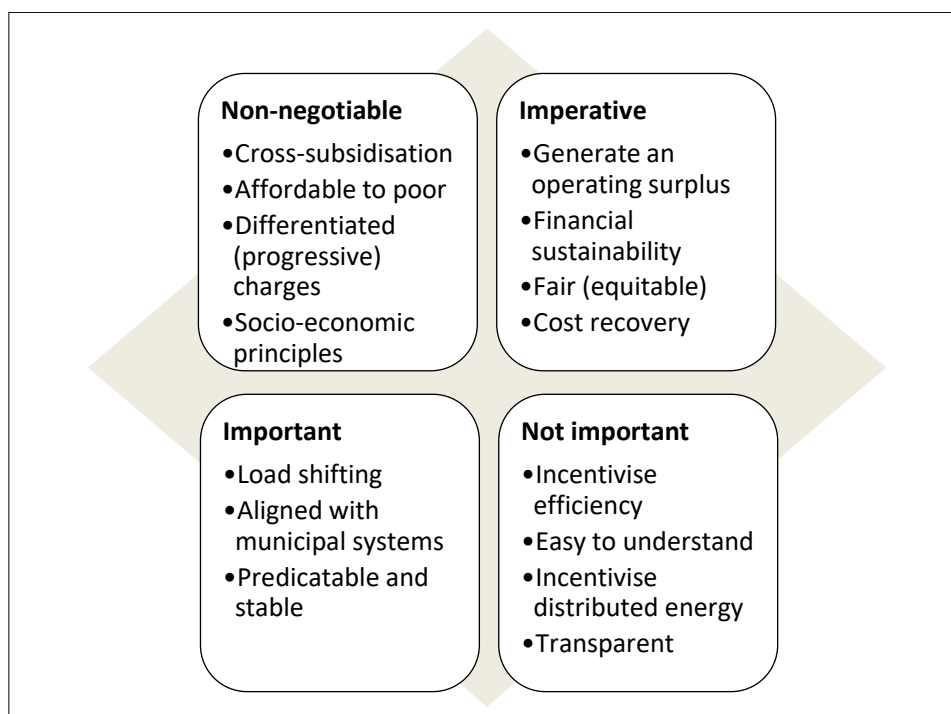
<sup>46</sup> i.e. high-end users subsidising the poor

affordability and cross-subsidies were non-negotiable tariff principles. This is expressed by the Head: Pricing and Regulation:

Tariffs inevitably have contrary interests but there is an absence of open debate around what local government electricity tariffs are really meant to achieve. But, for the Electricity Department we need to make sure the tariff is pro-poor (Interview 16. 16 September 2013).

This participant, the Head of Pricing and Regulation, is intimately involved in electricity tariff setting. The above statement is further entirely consistent with the formal position of the Electricity Department evident in policy documents such as the Electricity Department Business Plan (CCT, 2011f). This underscores that pro-poor electricity tariffs are not only entrenched in regulation and policy but also internalised in the institutional culture of the Electricity Department.

*Figure 5.7: Decision-making matrix for City of Cape Town electricity tariff setting<sup>47</sup>*



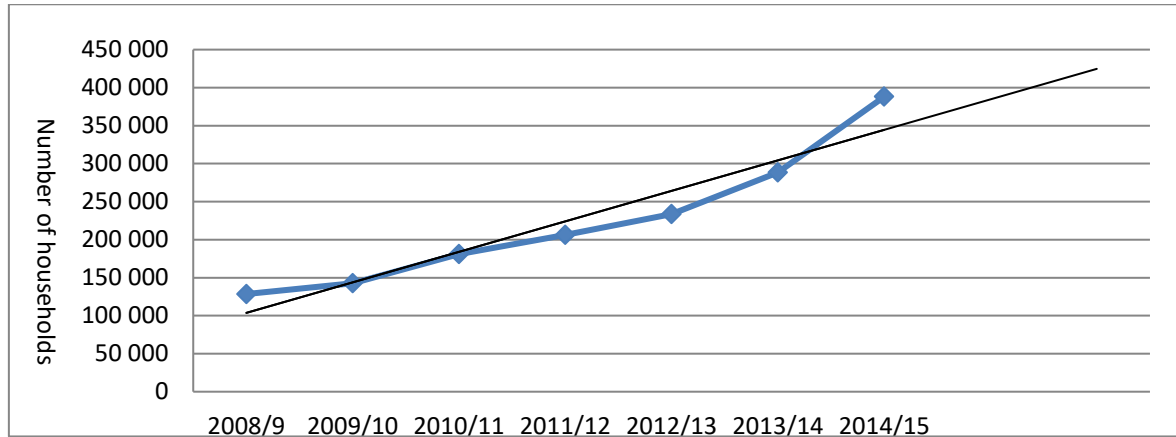
Third, a social safety-net in the form of free basic electricity (FBE) is facilitated by the municipal electricity regime. In terms the Free Basic Electricity Policy (DME, 2003b) municipalities are responsible for funding and implementing FBE. Partial funding for FBE comes from Equitable Share grants. However, the City provides free basic allowances far in excess of the national guideline<sup>48</sup> (DME, 2003c). Accordingly, there 'are many more people that qualify and the City has to fund the difference' (Interview 16. 16 September 2013). In order to understand the trend and extent to which the City funds FBE, multi-year data from IDPs (from 2008-2017) were analysed. As indicated

<sup>47</sup> Figure developed from interviews and observations with City officials alongside analysis of City policies and bylaws

<sup>48</sup> 50 units of free electricity to households using less than 150 units per month

in Figure 5.8 there is a sharp year-on-year incline in the number of households that require free basic allocations.

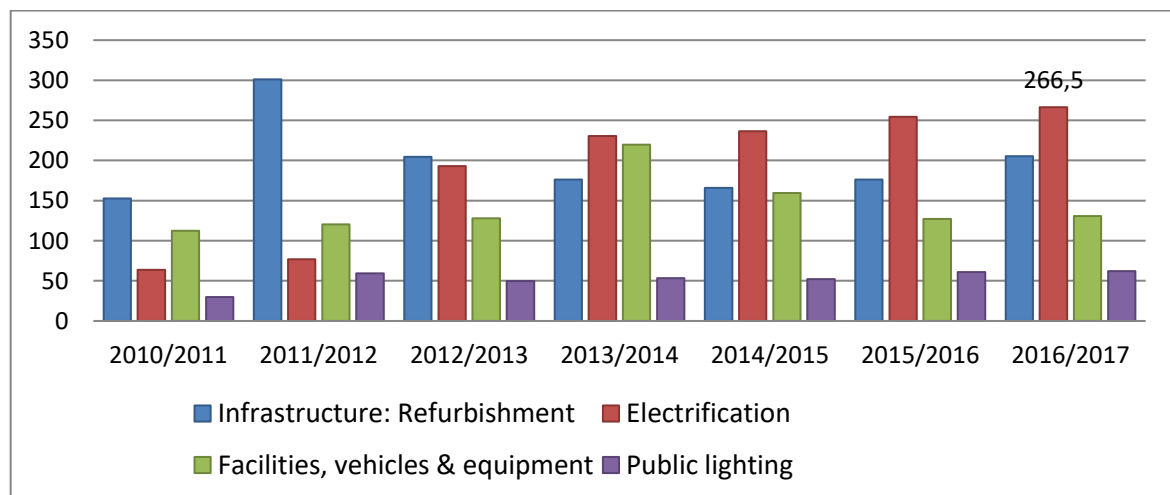
Figure 5.8: Number of households receiving free basic electricity in Cape Town



Source: Raw data from City of Cape Town IDP (2008-2012; 2012-2017)

Four, the City's electricity regime is evidently used as a means to facilitate socio-economic development through the provision of energy-related services to low-income households. This objective is explicit in a suite of policy documents including the City's IDP (CCT, 2010c) and Electricity Department Business Plan (CCT, 2011f) that indicate a considerable portion of the City's electricity budget is targeted to low-income households for, *inter alia*, electrification and roll-out of energy services such as ceilings (CCT, 2012b). This is triangulated by analysis of data related to the Electricity Department's capital expenditure sourced from annual budgets. As shown in Figure 5.9 electrification of low-income households is the Electricity Department's largest capital expense. In 2016/2017 electrification costs reached R266 million (CCT, 2012b).

Figure 5.9: Electricity Department capital expenditure



Source: Raw data sourced from City of Cape Town Annual Budgets (2010-2017)



It is clear that the manner in which the City's electricity regime has been configured demonstrates features of a social contract, defined as an 'implicit agreement among the members of a society to cooperate for social benefits, by sacrificing some individual rights in exchange for mutual welfare' (Kinnear, 2000:2). Across interviews and observations the social inclusion and welfare principles embedded in the City's electricity regime were of paramount importance to the Electricity Department. These participants highlighted the important function of the grid in facilitating sharing and providing public goods in general. According to the Head: Green Energy:

The distribution grid and tariffs are a way to ensure social development and redistribution. Our grid was built for all Cape Town citizens and we will hold them to the responsibility to cover the costs of it no matter what. Part of staying in a city means paying a fair share for its infrastructural costs (Interview 11. 04 December 2012).

Similarly the Head: Pricing and Regulation said:

The wealthy cannot simply opt out of the grid. We need to ensure sharing of costs and a pro-poor policy. If the rich try and 'opt out' the City will just get that revenue from them in another way, such as transfer the electricity loss onto rates. Citizens get benefits from public infrastructure; they cannot pick and choose what they will pay for (Interview 16. 16 September 2013).

The above underscores that the Electricity Department regards and conceptualises the City's electricity regime as a compact built for the benefit of citizens. For instance, during a Workshop on Urban Energy Policy Development the Head of Green Energy stated that customers that make use of and benefit from the grid implicitly 'contract to uphold the principles that underpin it' (Meeting 40. 19 November 2012). This framing is not only apparent from the positions of Electricity Department officials, but is also explicit in policy and reports developed by the department, that stress the role of the grid in redistribution (CCT, 2011f). Eberhard (2010) emphasises that, following the collapse of apartheid, national and municipal distribution grids were re-conceptualised with principles of social inclusion and re-distribution in mind. Therefore, a social contract was entrenched in national energy policy and legislation, which equally laid the foundation for the City's incumbent electricity regime.

### 5.2.3. Systemic tensions and opposing values in the incumbent electricity regime

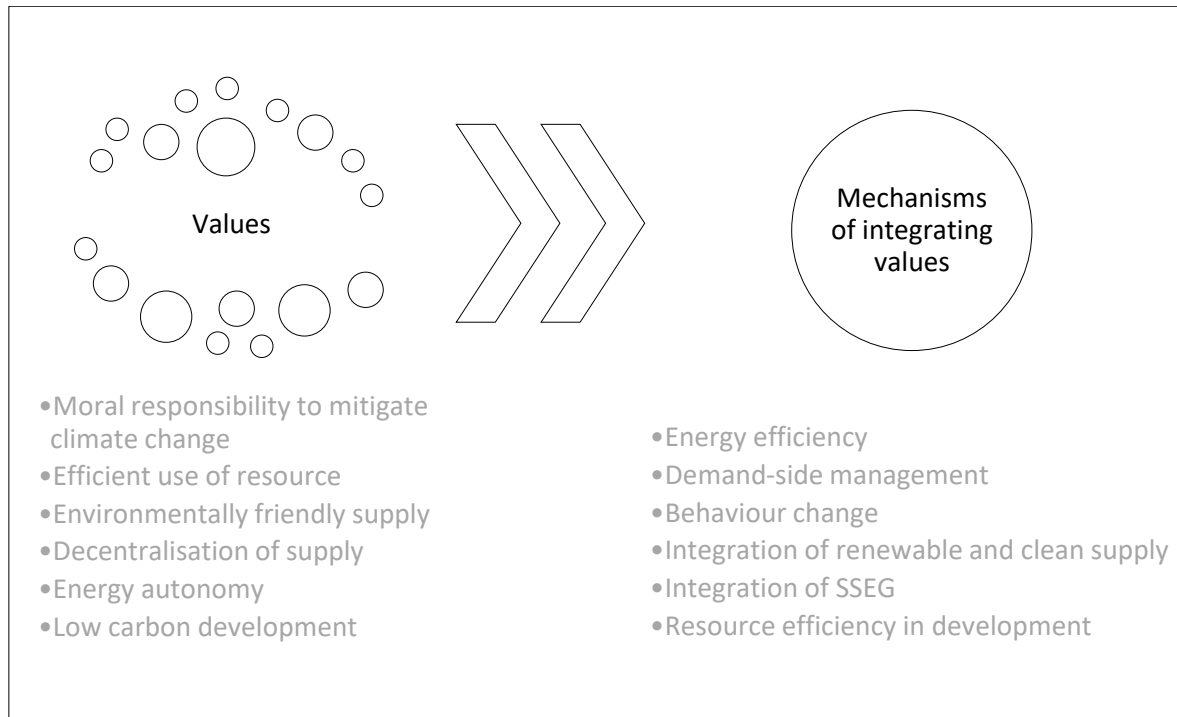
The above-mentioned values (developmental) are highly integrated in the municipal electricity regime. However, it is evident that there are attempts, by a range of stakeholders<sup>49</sup> to gradually integrate a new set of values into the regime. These may be broadly categorised as environmental values. The means sought to assimilate these values are primarily through integrating renewable

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<sup>49</sup> See Section 6.2.5

energy, SSEG, energy efficiency and demand-side management technologies into the incumbent regime<sup>50</sup>.

*Figure 5.10: Environmental regime values related to City of Cape Town electricity regime*

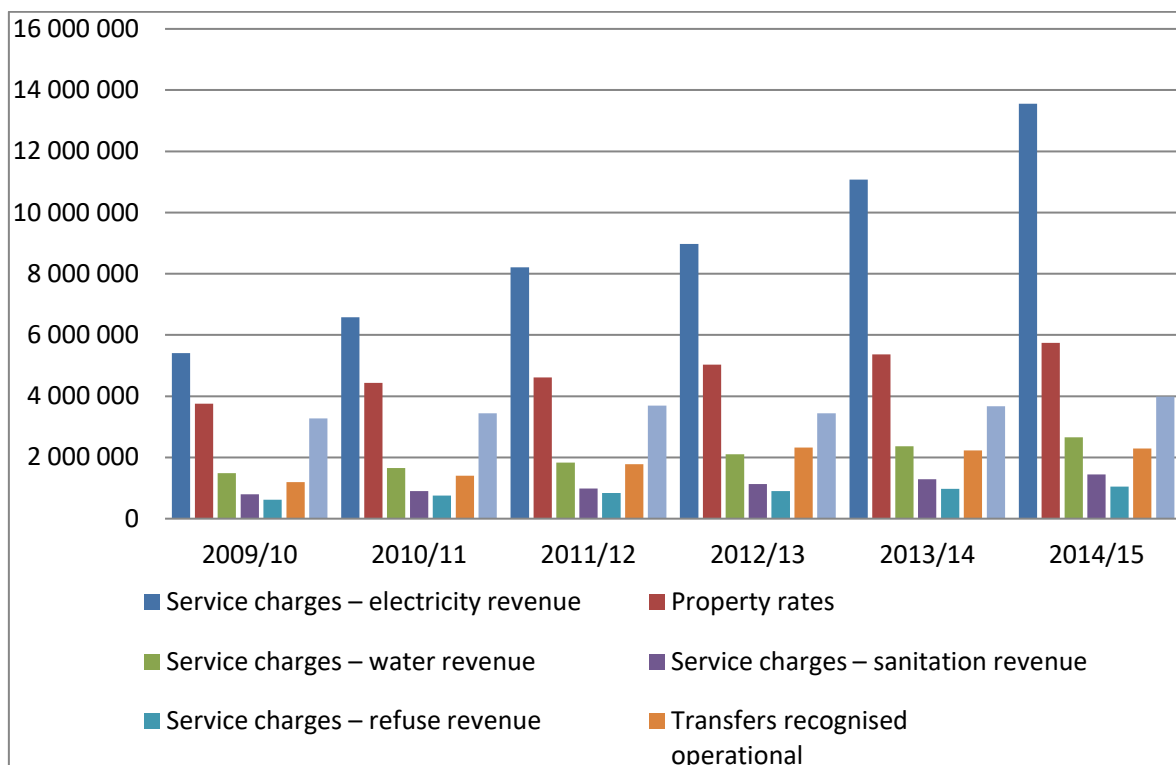


This section highlights the ways in which integrating these environmental values may result in fissures in the regime related to reproduction of development values, such as collapsing a business model based on redistribution. These may be regarded as systemic tensions in the City's electricity regime related to opposing values.

Several City reports including the City's Budget (CCT, 2012b) and Electricity Department Business Plan (CCT, 2011f) indicate that electricity sales form the backbone of revenue. In order to understand the extent of this contribution, multi-year data on electricity revenue, sourced from a range of documents, was analysed. Figure 5.11 indicates that the contribution of electricity sales to total revenue has increased steadily between 2008 and 2015. Although, across all years, electricity provides the largest contribution to total revenue, its percentage contribution is also escalating. Moreover, the surcharge and hence the City's profit on sales has also increased rapidly (CCT, 2012b).

<sup>50</sup> See Section 5.3.4

Figure 5.11: Revenue contributions by source in Rands (Thousands)



Source: Data sourced from City of Cape Town Annual Budgets (2008/09--2014/15)

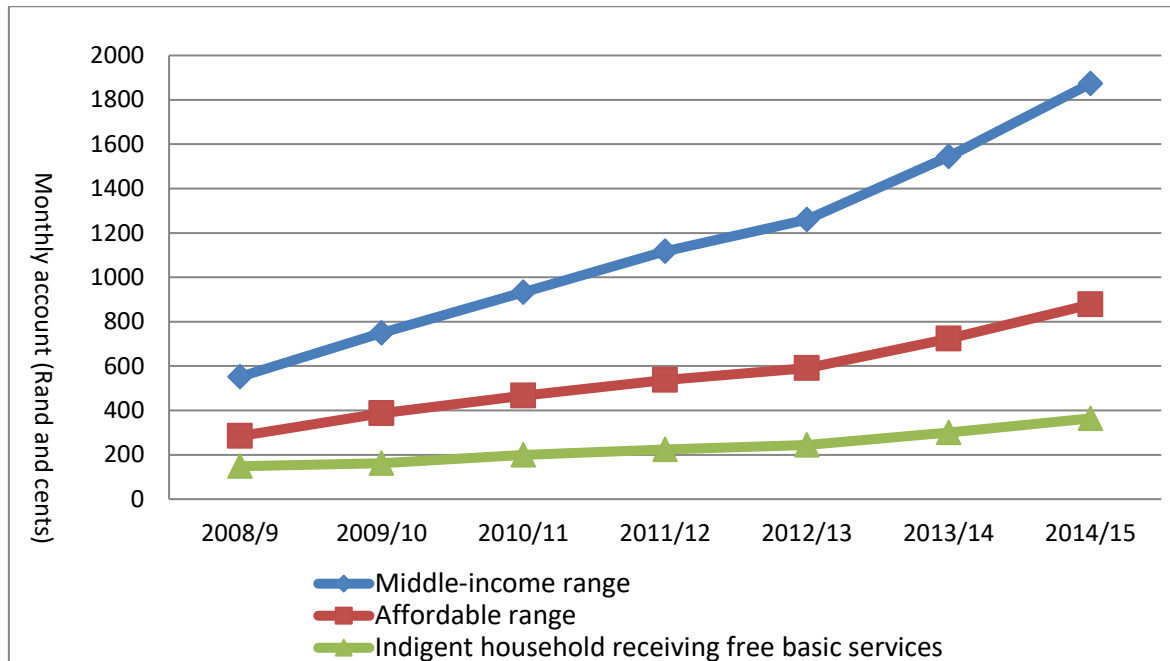
The City's significant dependence on electricity revenue provides an institutional motivation to increase electricity consumption. During interviews and observations, officials in ERMD repeatedly stressed the resultant lack of support for efforts to reduce electricity consumption (Principal Engineer: Energy and Climate. Interview 20. 23 August 2013). Notably, this 'perverse incentive' extends across the entire administration due to electricity revenue subsidising the general municipal fiscus. The extent of this 'disincentive' is further documented in independent research by Sustainable Energy Africa (SEA, 2013a) and research by officials in the Energy and Climate Change Unit (Laurent and Trollip, 2013).

As indicated, the ability of the City to provide affordable energy services to low-income households is dependent on its ability to not only maintain a continued revenue stream from mid- to high-income households and businesses but to increase this revenue. The IDP (CCT, 2012a) highlights that the demand and backlog of service delivery for low-income households, including electrification and the number of FBE recipients is increasing (see Figure 5.8). Provision of these expanding service needs is in turn dependent on extracting increasing revenue from the wealthy.

Conversely, it is evident that tariff increases are already 'providing an incentive' to wealthy households and businesses to reduce consumption. As represented in Figure 5.12, analysis of tariff

increases across multiple years (2008-2015), for households according to income levels, indicate a steep increase for mid and high-income electricity users.

Figure 5.12: Impact of tariff increases on households (monthly account) by income



Source: Data sourced from annual electricity tariffs published on the Electricity Department website (2008-2015).

This is articulated by the Head of Pricing and Regulation:

So what's happened in the past is that your wealthier customers have been paying extra to subsidise the system. Now, thanks to solar water heater, etc. it's possible to dramatically lower your electricity account. We've seen, over the past couple of years, about 300 million units knocked off the top of our domestic sales. The price has gone up to a point where it's a no-brainer (Interview 16. 16 September 2013).

In triangulation, research by officials in ERMD (Laurent and Trollip, 2013; Trollip et al., 2012) outline the extent of potential impacts of EE and SSEG on the City's capacity to cross-subsidise the poor. The results indicate that within the next decade uptake of energy efficiency technologies are expected to be high and hence,

[u]p to 80% of the cross subsidisation of the low income tariff could be affected, or up to half of the total amount of revenue allowed to be transferred to the rates account (Laurent and Trollip, 2013).

From the above it is evident that the City is in the midst of a situation comparable to a utility death spiral, namely revenue loss resulting from a unique combination of technology change, price elasticity and behaviour change (Felder and Athawale, 2014). However, the features of a 'death spiral', occurring in South African municipal electricity distribution networks are further

accompanied by a 'double whammy' (Janisch et al., 2012) where they threaten not only the revenue models of utilities, but also the development values that underpin them. Thus, rather than a 'death spiral', these systems could be regarded as in 'life support'. In the language of the MLP, private green niche innovations underpinned by environmental values are increasingly acting as a landscape pressure on the incumbent municipal revenue and business model and consequently the developmental values that are embedded in the City's electricity regime.

#### 5.2.4. Contested sustainabilities in the City of Cape Town's energy transition

The above outlines the systemic tensions between environmental and development values, as well as tensions between values and means of implementation, related to the City's electricity regime. This section outlines policy tensions or competing sustainability agendas in relation to plans to reconfigure the City's electricity regime. On the one hand, the City has committed to reconfiguring its electricity regime based on a range of development indicators. This can be seen as an expansion and consolidation of the development values that currently underpin its electricity regime. This agenda is driven by the Utilities Directorate and is widely supported by the Finance Directorate, the Mayoral Committee and Executive Management. This reconfiguration plan is entrenched in a range of City policies including its IDP (CCT, 2012a), Electricity Supply By-law (CCT, 2009b), Tariff By-law (CCT, 2007a) and Electricity Department Business Plan (CCT, 2011f). The targets and indicators for this reconfiguration agenda include a target to install 1500 subsidised electricity connections to low-cost housing, rental stock and informal settlements; a long-term target to ensure 93.8% of households have access to basic levels of electricity (CCT, 2012a); ensure electricity provision to backyarders through a Backyarder Service Programme; an expansion of FBE provision (CCT, 2011f); maintaining affordable tariffs (CCT, 2007a) and roll-out of an Energy Services Programme to low-income households (CCT, 2012a). In brief, the development indicators of this agenda include, *inter alia*, energy poverty alleviation, cross-subsidisation, reducing inequality, universal access to electricity and energy services, affordability and provision of FBE.

On the other hand, the City has committed to reconfiguring its electricity regime based on a range of environmental indicators. This agenda has been driven by stakeholders both in the City (Energy and Climate Change Unit) and non-state actors such as Sustainable Energy Africa<sup>51</sup>. This reconfiguration plan is entrenched in a range of different policies and plans, including the Energy and Climate Change Strategy (CCT, 2006d), ECAP (CCT, 2010a), Integrated Metropolitan Environmental Plan (CCT, 2003a) and Air Quality Management By-law (CCT, 2010g). Notably, the ECAP sets out 11 objectives that include: city-wide 10% reduction in electricity consumption, 10%

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<sup>51</sup> See Section 6.2.5

reduction in energy consumption of council operations, a target to meet 10% of energy supply from renewable and cleaner energy by 2020, build a more resource efficient city and promote behaviour change. The indicators for measuring improvements in 'environmental performance' embedded in this reconfiguration agenda thus relate to, *inter alia*, low-carbon, resource efficient, smart and green technology deployment, diffusion of clean and renewable energy and consumption reduction (CCT, 2010a).

However, due to the way in which these agendas are framed, they are to some extent mutually exclusive. There are various ways in which these environmental and development reconfiguration policy agendas compete and contest in the City's energy transition. Notably, there is direct competition for budget allocation between environmental and development-oriented energy projects. The City has a low revenue base and hence a constrained budget (CCT, 2012b). Accordingly, officials working on 'low-carbon [environmental] programmes have very tight budgets' (Head: Energy and Climate Change. Interview 23. 26 August 2012). From observations in numerous Energy and Climate Change Portfolio Committee meetings it is clear that political priority is given to development-oriented projects, such as the roll-out of ceilings to low-income households rather than 'decarbonisation' projects targeting mid- to high-income households, such as a Mass Solar Water Heater Roll-out and SSEG (Meeting 19. 16 August 2012; Meeting 27. 13 September 2012).

More broadly, there is significant competition for policy preference in the City between reducing energy consumption of the wealthy, where major emissions reductions can be gained, and providing universal access to basic energy services. Thus policy-makers have to balance and navigate trade-offs between environmental and developmental imperatives. In this regard, the Head of Energy and Climate Change highlights that for expediency ERMD routinely frame EE and renewable energy projects in terms of 'job potential, labour intensity and economic development' (Interview 23. 26 August 2012). For instance, a big political selling point marketed in the City's Mass Solar Water Heater Programme is potential jobs in local manufacture and installation through providing local content requirements in tenders.

The main implication of development-oriented energy projects on environmental reconfiguration agendas is the resultant increase in Cape Town's total electricity consumption and associated emissions from programmes such as electrification of low-income households. In contrast, environmental agendas have a number of implications for developmental objectives.

First, the roll-out of low-carbon technologies may increase the costs of services to customers and hence exacerbate differentiated infrastructure provision. For instance, a Business Plan developed by the Electricity Department highlights that there would be significant costs associated with

replacing the City's existing stock of prepayment and credit meters with smart meters. In financing the roll-out, the Electricity Department proposed passing the cost onto the customer (CCT, 2013a). However, poor households already manage their consumption prudently and would thus gain limited benefit from smart meters. During a workshop hosted by GreenCape, an Electricity Department official proposed unbundling the service 'where a customer can pay for a smart meter if they request it and are able to afford it' (Meeting 54. GreenCape Smart Grids Workshop. 14 February 2013). This is a form of 'infrastructure consumerism' and 'differentiated infrastructure provision' whereby infrastructure is tailored to different user groups according to income (Pieterse, 2008; Jaglin, 2014).

Second, resource efficiency standards can potentially increase the costs of developments and disproportionately affect the poor. For example, national government amended the National Building Regulations and Building Standards Act, 2011 by including provisions for 'Environmental Sustainability'<sup>52</sup> in general and 'Energy Usage in Buildings'<sup>53</sup> in particular and subsequently introduced SANS 10400-XA (SANS, 2011a) and SANS 204 (SANS, 2011b) which mandates efficiency interventions for all new developments. Mid and high income households can absorb these costs more easily than the poor and the additional costs are a lower proportion of the total development costs than those experienced by low income households. Further, the Western Cape Provincial Government estimates that compliance with the standards adds large additional costs to delivery of subsidy housing. This is reiterated in a letter from the Premier of the Western Cape to the Minister of Trade and Industry:

SANS 10400 contains energy efficiency requirements that have the effect of increasing the cost of production of subsidised housing units by R30 000. The impact of the regulation in the 2013-14 financial year is that the provincial target of 11 802 houses set for the year will have to be reduced to 3200 - housing delivery would be reduced by as much as a third (PGWC, 2013).

Related, market-based regulatory instruments to incentivise decarbonisation, such as a proposed Carbon Tax, would also disproportionately impact on the poor. Comments by the City of Cape Town on the National Carbon Tax Policy Paper (National Treasury [NT], 2013a) argue that

[t]he underlying rationale of a carbon tax is to facilitate market innovation. Eskom is however a regulated monopoly that does not function under normal market conditions. Instead the costs of the Tax will in all likelihood be passed onto end-users. Whereas wealthy users have an option to shift to distributed generation or become more efficient to buffer costs, the Carbon Tax does not adequately address means of ensuring that the poor are not disproportionately impacted.

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<sup>52</sup> Part X

<sup>53</sup> Part XA

The above demonstrates that costs of internalising emissions, in contexts where market conditions do not operate, would be passed onto customers through tariff increases. Mid- to high-income households are better able to absorb these costs and the increases would be disproportionate in terms of total income. This highlights the potentially regressive nature and implications of market-based instruments in Global South contexts, with unique interactions between inequalities and regulated monopolies.

The above examples highlight the ways in which contested reconfiguration policy agendas compete for primacy in the City's overall 'sustainable' energy transition narrative. Importantly, it appears that competition between these reconfiguration policy agendas is resulting in what may be termed a hybrid reconfiguration. As discussed, due to a complex set of drivers, including the City's energy and climate policy, tariff increases and availability of low-carbon technologies, the City's electricity regime is beginning to exhibit features of a more environmentally sustainable configuration. This includes limited penetration of SSEG, solar-water heaters, larger-scale renewable electricity supply, smart meters and more efficient buildings (CCT, 2015a). On the other hand, the preceding sections outlined the ways in which the incumbent electricity regime has and continues to be reconfigured to support development.<sup>54</sup> Thus, a hybrid system is emerging, comprised of a mix of informal and formal energy infrastructures, differentiated infrastructures, green infrastructures and pro-poor energy infrastructures.

#### 5.2.5. The technical and green bias in transition initiatives

The above section outlines two competing sustainability agendas in the City and the extent to which they are mutually exclusive. This section narrows the focus to examining two energy initiatives, each of which epitomise the above contested agendas. These are SSEG through net-metering (environmental agenda) and electrification of informal settlements (social agenda). SSEG through net-metering has been identified as a key 'supply substitution' for a sustainable energy transition by various STS authors (Geels, 2002; Smith and Stirling, 2008). Conversely, electrification of informal settlements has not been examined within a transition framework despite the considerable impact electrification has on social sustainability. These two examples are particularly relevant for exploring issues related to, *inter alia*, best practice, technology transfer and informal-formal dichotomies surrounding the MLP.

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<sup>54</sup> This merely highlights that there is a developmental window or lens in the incumbent regime, not that the current regime effectively addresses the needs of the urban poor. It only highlights that transforming the existing regime in a particular way will have implications for the features of the incumbent regime aimed towards energy poverty alleviation.



First, it is necessary to discuss the approach that implementing agents adopted in relation to each of these initiatives in order to interrogate conceptualisations of ‘best practice’. Net metering is widely regarded as a ‘best practice’ electricity policy, which allows private owners of renewable systems to sell their excess electricity onto a network. It has been adopted by many cities in the Global North including Australian, United States and EU cities (REN21, 2012). NERSA followed this international ‘best practice’ in promulgating the Standard Conditions (NERSA, 2011a) that stipulated that municipalities must incentivise SSEG through a net-metering tariff structure.<sup>55</sup> In complying with these standards, the City established the ‘net-metered domestic’ tariff (Figure 5.13). This was done in a top-down manner, with limited consultation, through duplicating Global North tariff structures and policies (North-South transfer). It is important to note that the Energy and Climate Change Unit and the private sector welcomed these standards on the basis of decarbonisation and security of supply, whereas the Electricity Department opposed them (CCT, 2012c; CCT, 2013c).

*Figure 5.13: City of Cape Town net-metering tariff structure*

			2012/2013 Excl. VAT
Net metered domestic	Service:	R/day	9.83
	Energy consumed:	c/kWh	91.69
	Energy generated:	c/kWh	91.69

Source: Net metered domestic tariff from City of Cape Town Budget (2012/2013)

In contrast, the City’s approach to electrification was bottom-up and applied lessons from other African cities undertaking informal electrification (South-South transfer). According to the Senior Officer: Electrification, a ‘champion’<sup>56</sup> was present in the City that pioneered informal electrification’ (Interview 8. 24 April 2013). A report by Sustainable Energy Africa (2012a) finds that the bottom-up formulation of a policy, that explicitly provided that it is the City’s responsibility to undertake electrification of informal settlements and backyarders, institutionally entrenched this position. The Electrification Unit pushed for a municipal budget to be allocated for informal electrification, which created ‘buy-in and commitment’ from top management. This bridged the funding gap of ‘infrequent and unstable’ Integrated National Electrification Programme (DOE, 2005) Grants from

<sup>55</sup> Excess generation is offset against future consumption on a unit for unit basis

<sup>56</sup> The term champion is common in multi-level climate governance literature and in this context refers to an official or politician in local government that drives or pioneers particular projects, usually related to energy or climate change.

national government (Interview 8. 24 April 2013). Further, close participation with 'communities and shared decision-making' was undertaken by the Electrification Unit.

Second, it is necessary to contrast the context-specific implications of each. Notably, net-metering would impact on the integrity of the City's revenue system. The largest uptake of SSEG would be from mid- to high-end users as they can afford the high upfront capital costs and are motivated due to rising tariffs<sup>57</sup>. A model undertaken by Sustainable Energy Africa examines the extent of the potential revenue impact. It finds that SSEG could result in up to 15% revenue loss in the medium-term and collapse the municipal revenue system in the longer-term (Janisch et al., 2012; SEA, 2012b). Across interviews and in numerous meetings, senior officials in the Electricity Department raised concerns over the potential impacts on the City's revenue model.

Importantly, the resultant revenue loss of net-metering would impact on the poor. As the uptake of SSEG would be predominantly mid and high-end users, it would reduce the capacity for cross-subsidisation. Further, it would reduce the contribution of electricity sales to general municipal services and the Electricity Department's capital budget and hence the roll-out of energy services to indigent communities (SEA, 2012b, Laurent and Trollip, 2013; Trollip *et al.*, 2012; Janisch *et al.*, 2012). Net-metering would thus reinforce the incumbent political economy in relation to energy infrastructure and enhance a dual system of electricity services (Jaglin, 2012). Notably, net-metering would be a subsidy for the wealthy at the expense of the poor. This is highlighted through examining the structure of the tariff alongside the specifics of when the City purchases and re-sells electricity.

In brief, the City buys bulk electricity from Eskom at a fluctuating rate based on time of day (CCT, 2012d) and resells to customers at a fixed rate. SSEG installations (solar) generate electricity during day-time when system owners will generally not be consuming electricity. During day-time the City purchases electricity at a cheap rate.<sup>58</sup> Thus, the City would be paying more for electricity purchased from net-metered customers than from Eskom. Conversely, during peak demand the City buys electricity at a high rate<sup>59</sup> and re-sells at a lower rate. During peak demand<sup>60</sup> SSEG systems do not generate and net-metered customers would accordingly consume grid electricity. Thus, net-metered customer will be charged far less per unit than the cost to the City. In brief, this structure would result in the City making a loss and having to subsidise wealthy net-metered customers.

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<sup>57</sup> See Section 5.2.3

<sup>58</sup> Less than 91 cents per unit.

<sup>59</sup> Approximately R2.50 per unit.

<sup>60</sup> Evenings and mornings

Across interviews Electricity Department officials expressed concern related to the impact of net-metering in Cape Town's socio-economic context, i.e. subsidising wealthy customers at the expense of the poor. The Head of Green Energy, for instance, said:

In Cape Town and South Africa a net metering tariff would be a subsidy. It would be subsidising the interests of the wealthy and corporates, namely those that can afford to put solar PV systems up, at the ratepayers' expense (Interview 11. 04 December 2012).

The above participant is a senior official in the Electricity Department that leads the department in policy and implementation related to renewable energy and energy efficiency. This is a somewhat conflicted position whereby the participant understands the rationalities of the department and the function of the distribution grid in socio-economic development and at the same time is driving projects that may negatively impact on these principles. Thus, the above statement comes from a position of technical knowledge of the bounded rationality of department. This position is reiterated by the Manager: Technical Strategic Support:

A city like Cape Town is not the same socio-economically as Munich. We have large informal settlements without electricity. With increasing urbanisation informal settlements are mushrooming. This requires more connections, larger FBE allocations ... This means larger cross-subsidies from the wealthy. We cannot just copy solutions that have worked in cities like Munich (Interview 6. 03 September 2013).

The above argument against net-metering, by a senior manager in the Utilities Directorate, stems from a narrow understanding of electrification and cross-subsidies as a primary means of energy poverty alleviation in contrast to a thorough assessment of the actual energy service needs from the perspective of the urban poor. Nevertheless, the statement stresses the potential socio-economic outcomes of directly transplanting transition measures and technical solutions from the Global North, in a top-down manner, to infrastructure regimes in cities where large fiscal transfers between the rich and poor are present. Notably, 'best practice' may reinforce incumbent political economies and disrupt the public good functions of infrastructure in favour of private niche innovation. In contrast, electrification of informal settlements may be conceptualised as the public-led extension of public goods, facilitated by socio-technical infrastructure, to historically marginalised users. Whereas net-metering would benefit and subsidise the rich, informal electrification subsidises the poor.

Third, it is necessary to explore the extent to which each approach resembled innovation and adaptiveness to context. As mentioned, the approach to net-metering was in essence 'copy-and-paste' with limited consideration of context. Conversely, the City's approach to electrification was adaptive to Global South conditions, particularly formal-informal dichotomies.

In background, it is evident that national legislation related to electrification is framed with a 'formal'<sup>61</sup> electricity system in mind. The Policy Guidelines for Electrification of Unproclaimed Areas (DOE, 2011f) prescribe a range of criteria that must be met before an area can be electrified. Notably, an informal settlement must be in close proximity to formal infrastructure and must not be on private land. Most informal settlements thus do not qualify (SEA, 2014a). As highlighted by Silver and Marvin (2016), the 'struggles for recognition of land are highly coupled with electricity infrastructure provision'. Further, there are stringent formal standards that municipalities must comply with for electrification (SANS, 2005a; SANS, 2005b; and SANS, 2005c) that are 'incompatible' with electrification of informal settlements (SEA, 2011). According to a Senior Officer in the Electrification Unit, informal electrification plans are often rejected on grounds of non-compliance with regulations related to public safety, formal land-use planning and environmental management (Interview 8. 24 April 2013).

Nevertheless, the City demonstrated an innovative response to the 'formal-bias' in regulation. Notably, a lenient 'interpretation of formal electrification regulation and criteria was adopted' (SEA, 2012a). Further, an innovative technical solution was developed in response to formal technical standards, applying lessons gained from in situ upgrading of informal settlements in Brazil, whereby the City used 'a maypole with a connector box in response to informal layout and inability to lay electricity lines as in formal areas' (SEA, 2014a). The City's Electrification Unit reiterates that 'regulation should acknowledge and accommodate differences between electrification of informal settlements and formal residential areas' (Interview 8. 24 April 2013).

It is evident that the City's approach to informal electrification resembles qualities of socio-technical innovation and features of a reconfiguration process that achieves a range of sustainability criteria. This highlights that an initiative that may be atypical as a transition mechanism may fit comfortably in a transition framework. Inversely, cases that are commonly considered within a transition framework, such as SSEG and net-metering, may sit awkwardly within such a framework when tested in different, particularly Global South, contexts. This brings to the fore, *inter alia*, the informal and formal dichotomies of Global South socio-technical regimes and associated implications for transition initiatives, the value in examining beneficiaries and political economies of reconfigurations, 'innovation in context' and issues related to North-South and South-South knowledge transfer.

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<sup>61</sup> It is acknowledged that the distinction between formality and informality is conceptually complicated (Huchzermeyer, 2011). This section refers only to the City's formal and informal electricity system as defined in regulation and policy.

### 5.2.6. Justice and scalar implications of urban transitions

The above sections outline tensions (both systemic and policy-based) related to the City of CT's electricity regime. This section focuses on the nested spatial dimensions of these tensions and the ways in which they are manifest in relation to both the structural and functional relationship between national and urban electricity regimes and within policy agendas of different spheres of government.

There is an increasing drive from a range of stakeholders including the Energy and Climate Change Unit, several Councillors and sector development agencies such as GreenCape for pursuing greater urban energy autonomy.<sup>62</sup> These stakeholders are driving plans for the City to generate its own large-scale renewable electricity or enter into power purchase agreements (PPA) with independent power producers (CCT, 2012a; SEA, 2012). This ambition, for increased urban autonomy over a traditional national competency, is further observable in a range of analogous large infrastructure areas, including steps taken by the City towards increased control and decentralisation related to rail and transport infrastructure (CCT, 2012a). On the other hand, national government agencies such as the Department of Energy, NERSA and Eskom oppose the City's attempts at increased control over energy supply. The Electricity Department is closer aligned to national government's position in this regard.

There are a number of reasons for this contestation. Notably, the tensions are revenue related. According to 2016 figures, Eskom generates approximately R66 billion in revenue from bulk sales to municipalities. This accounts for up to 40% of Eskom's total revenue (NT, 2017). The City of CT, in the 2012 financial year, paid Eskom approximately R5.5 billion for bulk electricity (CCT, 2012b). Thus, not only would decentralised supply relate to direct revenue loss, but it would also set a precarious precedent for Eskom and the Department of Energy of other metropolitan municipalities following suit. The City's Electricity Department, that generates revenue from resale of these bulk purchases, likewise seeks to uphold this arrangement.

Second, the tensions are a result of contested securities. Actors pursuing energy autonomy argue that localised electricity generation is needed to guarantee security and reliability of supply, reduce risks of load shedding and rolling black outs, ensure price certainty and to protect urban economic activities against these associated risks. This rationale is documented in a number of reports and project proposals (CCT, 2011a; CCT, 2011b) and expressed in several interviews and observations. For instance, the Head of Energy and Climate Change said:

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<sup>62</sup> The critical question of autonomy in relation to the City's energy transition is addressed in more detail in Chapter 7, particularly Section 7.2.2.

Local government cannot continue to rely on national electricity planning. We need greater energy autonomy (Interview 23. 26 August 2012).

Third, the contestation is based on divergent values. Proponents for retaining centralised networks tended to underpin their argument within a developmental lens. They argue that national grids are instruments for sharing costs and benefits across national boundaries and that these principles are entrenched in legal instruments such as the Electricity Regulation Act, 2006. This position more or less aligns with the aim of preventing 'patchy' (Coenen and Truffer, 2012) distribution of development and using the grid for redistribution.

Four, the tensions are underpinned by opposing views on climate change responsibilities. On the one hand, actors that advocate for energy autonomy argue that wealthier cities have a moral responsibility to mitigate climate change. In contrast, national government and the Electricity Department argue for differentiated responsibility for climate mitigation vis-à-vis Global North-South. This was captured by the Head of Pricing and Regulation:

Climate change is not caused by African cities. South Africa has proven itself a leader in mitigation. Why should a South African city go further at the expense of the poor? There is very little political will in Cape Town to charge customers more for green electricity, particularly when energy poverty is a major challenge (Interview 16. 16 September 2013).

These opposing views were visible in a multi-stakeholder *Workshop on Low Carbon City Centre Strategy* where a proponent for energy autonomy argued that the City has a responsibility to facilitate widespread localised renewable electricity (Meeting 68. Cape Town Partnership. 23 April 2013). In response, the Head of Green Energy raised the following argument against energy decentralisation and autonomy:

If local governments go at it alone on large scale renewable and 'cleaner' energy, it means reduced resources and funding for national energy planning and hence energy services to the poor. National is the best scale for decarbonising supply (Interview 11. 04 December 2012).

Five, these tensions are based on different metrics and assessments of costs and implications for the poor. The Electricity Department and national government argue that large-scale renewable electricity would cost more than electricity from the national blended grid (CCT, 2011h). Thus, if the City were to enter into a PPA the associated increase in bulk electricity costs would be passed on to customers through tariff increases. As argued by the Head: Green Energy, this would disproportionately affect the poor:

Increased tariffs stemming from green electricity will effect the poor the most which is politically indefensible in Cape Town... Local governments cannot charge people more for green electricity (Interview 11. 04 December 2012).

The basis for the above statement is that the poor are disproportionately affected by tariff increases arising from renewable energy, as a larger proportion of total income is spent on electricity (CCT, 2011j). Conversely, proponents for energy autonomy argue that the costs of large-scale renewable energy will become cost competitive with the national grid price in the medium term. A report drafted by the Energy and Climate Change Unit argues:

Given cost projections it appears that there might be considerable scope for CCT, or CCT electricity customers to benefit from electricity generated at costs lower than the national grid price (CCT, 2011i: 3).

Further, they highlight that the economic benefits, including localised jobs and security of supply should be considered in an assessment of cost (CCT, 2012f).

Finally, an argument raised by proponents of centralised networks relates to cross-subsidies between wealthy metros and poorer municipalities. In brief, municipalities in South Africa contribute varying amounts to Eskom revenue from bulk purchases. Poorer municipalities receive a discounted rate on bulk electricity (SEA, 2015) and large metros consume far more electricity. Thus, wealthier metros contribute considerably to national supply, transmission and distribution and thus cross-subsidise poorer regions<sup>63</sup>. Hence, urban energy autonomy in wealthier cities impacts on this intra-city cross-subsidisation. This argument has been raised by both Eskom and NERSA (Eskom, 2012; CCT, 2011g; CCT, 2011h), summarised by the Eskom's Chief Engineer: Network Planning:

Eskom needs to continue getting bulk sales and revenue from Cape Town. It is the responsibility of wealthier metros to play their part in supporting smaller municipalities and rural electrification. One of the reasons for renewable electricity being supplied on the national level is because the cost of renewables is more. With national grids, the cost of electricity is spread and cross-subsidies are not as threatened (Eskom, 2010).

This situation is compounded by recent trends related to electricity reconfigurations in large South African metros. An analysis of data provided by the Sustainable Energy Africa indicates that revenue is declining across South African metros. Figure 5.14 highlights that net deficits in electricity sales surplus are inevitable for metros in the coming years. The 'State of Energy in South African Cities' highlights that large South African metros<sup>64</sup> have already reported large decreases in electricity sales whereas secondary cities are reporting net deficits (SEA, 2015). This means that rather than electricity sales subsidising general municipal services, electricity services would have to be subsidised from other revenue sources. Thus, intra-city cross-subsidisation is already being reduced

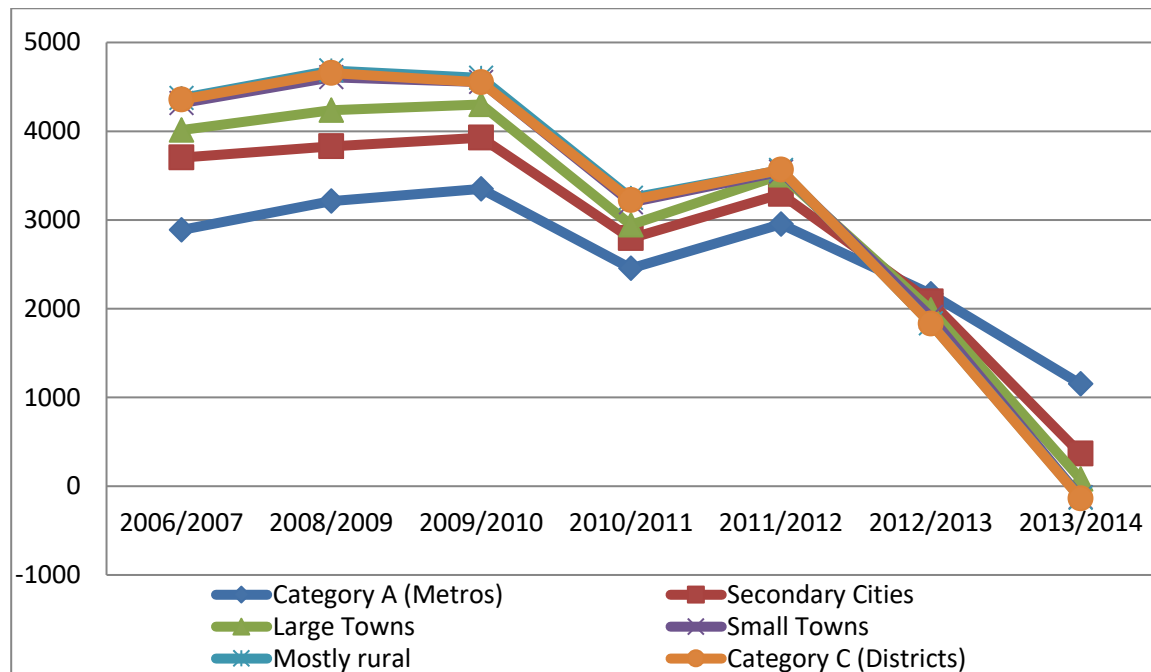
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<sup>63</sup> Through, *inter alia*, financing electrification and energy service provision

<sup>64</sup> Including the City of Johannesburg

by socio-technical reconfigurations. These trends are thus caused by and will be further exacerbated by urban energy transitions.

Figure 5.14: Electricity surplus for categories of South African municipalities



Source: Raw data sourced from local government MTREF budgets (2006-2014)

The case of large-scale renewable electricity provides a strong example of tensions between urban transitions and autonomy and national development aspirations. These structural tensions, that cut across levels of government, are manifested by conflicting visions, values and understandings amongst social groupings. This highlights the complex relationships between scale, contestation and justice in relation to reconfigurations of urban infrastructure networks that are (inter)-connected with national grids. Notably, it brings to the fore opposing securities of urban ecological security the one hand, and national developmental transitions on the other. In brief, it illustrates that wealthy municipalities 'going it alone' in urban transitions may conflict with national development ambitions or transitions.

### 5.3. Discussion

#### 5.3.1. Differentiating regimes in the Global South

This chapter highlights that the City's electricity regime is splintered; divided between an infrastructure-securitised system that services a formal middle-class on the one hand and a system characterised by growing informality and marginalisation in relation to infrastructure on the other hand. Thus, the relationship between the technical and the social is knotty in respect of Global



South infrastructure regimes. These are beset by inequities, infrastructure poverty, formal and informal infrastructure dichotomies (Filion and Keil, 2017) and differentiation (Monstadt, 2009), multiple infrastructure, fuel and livelihood strategies and infrastructure marginalisation. Notably, this chapter identified the presence of hybridity in socio-technical regimes in relation to the formal and informal and the interactions and blurring between these dichotomies. Socio-technical regimes in the Global South are thus plagued by dual or differentiated (Jaglin, 2008) systems of infrastructure provision. The prominence of inequality and differentiated service provision in regimes in the Global South bring a multitude of questions to the fore of relevance to the MLP. These include a transition for whom? Which socio-technical system is being transitioned, the formal or informal infrastructure system? Who are the beneficiaries of transition processes? Who pays for and who suffers (Schlosberg, 2012a; Schlosberg, 2012b; Myers, 2011) from particular processes of socio-technical reconfigurations and how is risk and benefit allocated in decision-making related to infrastructure reconfigurations? These questions, central to PE and environmental justice, become patent when exploring socio-technical regimes in the Global South. This reasserts the theoretical value of tempering the MLP with a political ecology lens (Lawhon and Murphy, 2011; Murphy, 2015) when exploring regimes in the Global South. Further, the degree of infrastructure poverty in cities in the Global South makes comparisons with socio-technical regimes in the Global North difficult. Related, the relationship between access to and beneficiaries of socio-technical infrastructure and socio-economic development is central to understanding regimes and reconfigurations in the Global South.

Second, South Africa's electricity-related institutional landscape and by extension electricity-related institutional landscapes in South African cities, differs substantially from typical electricity regimes in the Global North. These include utilities that are regulated monopolies; an absence of an independent market operator; lack of competition in energy supply; and bundled transmission, distribution and generation. Alongside and partly as a result of the above, niche innovations and niche firms are less prolific in the Global South. These features provide important insights for transition theories. Primarily, as infrastructure regimes in the Global South are more centralised and less competitive, the capacity for private 'niche' disruption is limited. Thus, transition processes, including the stimulation of niche innovations and 'mainstreaming' them into network infrastructure, is more dependent on state intervention. Accordingly, it becomes necessary to conceptually distinguish between private and public-led transitions, depending on the prominence of niche firms or the state. Importantly, the dominance of the private sector versus the state in facilitating transitions is tied into Global South-North geographies, with the state playing a larger role in regulated monopolies or even 'hybrid' (Eberhard, 2010) infrastructure markets. There are

further distinguishing features between the strengths of public-versus-private-led transitions. In brief, public driven transitions may be better able to maintain public goods<sup>65</sup> but without stimulating the efficiency and competition that facilitate emergent complex adaptive systems. Inversely, private sector-driven transitions (disruptions) are underpinned by quasi-evolutionary properties (competition) yet result in transformed regimes that are not able to fully maintain public goods embedded in regimes.

Third, exploring an infrastructure regime in a city in the Global South brings up a range of spatial and scalar dynamics that provide insight into the relationship between cities and the niche-regime-landscape hierarchy. It is evident that national socio-technical infrastructure regimes are highly entangled, not only with municipal infrastructure regimes, but also municipal functions (service delivery and planning) and the structure of cities in general. Thus, it is possible to argue that the functional systems of cities identified by Pieterse (2008), namely operating, infrastructural, economic and spatial systems, are extensions of and reinforcing instruments of national socio-technical regimes. In this way, urban regimes (as lower agglomerations) both mirror and reinforce underlying modes of thought, logics and functions of national socio-technical regimes. Various sub-systems of urban regimes are thus enmeshed with and co-evolve alongside both national, centralised infrastructure regimes and wider municipal functions. Finally, it is worth noting that historical spatial patterns of socio-technical networks result in spatial externalities, whereby the negative impacts of regimes<sup>66</sup> are located far from the areas of consumption. These may be termed 'regime externalities'.

### 5.3.2. (Re)framing regimes as value systems and social contracts

Socio-technical systems literature focuses on a range of elements that are solidified and entrenched within the structure of regimes including technology, regulation, markets and infrastructure (Geels, 2004). However, sustainable transition theory overlooks values as an element that both stabilises and is stabilised within socio-technical regimes. Conversely, this chapter highlights that values both drive and are deeply entrenched in socio-technical regimes.

This chapter demonstrated that the City's electricity regime is structured to facilitate a range of values such as redistribution, social security, universal access to services in support of socio-economic development and affordable electricity for the poor. More than merely being embedded in the regime structure it is evident that values are central to the way in which the City's incumbent electricity regime is in fact configured. Moreover, it is evident that values both co-evolve alongside

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<sup>65</sup> See Section 5.3.2

<sup>66</sup> Such as air pollution, associated health impacts and environmental degradation

and exert a strong structuring force on other regime elements. Notably, values play a large role in shaping the physical infrastructure of socio-technical regimes. For example, electrification (underpinned by a value of universal access) creates new infrastructure in the form of transmission lines for new connections. This highlights that socio-technical regimes are both shaped by and underpinned by values. These may be referred to as 'regime values'. Through this lens socio-technical systems may be (re)conceptualised as systems that integrate and house different values (and belief systems) and sets of coupled values.

Second, sustainable transition cases that focus on electricity systems are commonly underpinned by notions that State-owned electricity systems are archaic and inefficient models for service delivery and sustainable transitions are thus underlain and achieved through forms of privatisation, fostering private sector technology development and encouraging individualised and decentralised innovations (Rifkin, 2011; Rutter and Keirstead, 2012). This chapter demonstrated that privatisation and 'disrupting' centralised grids, commonly identified as a precondition for achieving sustainable transitions in electricity networks, create systemic tensions overlooked in theory. This challenges the neo-liberal tendencies present in sustainable energy transition research and practice, that focuses on the power of decentralised, liberalised and distributed energy systems to facilitate sustainable change and elevates the role of market-driven competition and private sector innovation (Jamasb and Pollitt, 2008; IEA, 2014). Conversely, this chapter highlights the function of network infrastructure as systems to administer social and public goods, in theory and policy; and the disjuncture between service provision and sustainability innovation. This emphasis pays greater attention to the 'equity deficit' (Satterthwaite, 2007) and differentiated infrastructure (Savage and Ward, 2003) that may accompany reconfigurations of socio-technical regimes. Notably, it provides a more relevant foci for examining transitions in contexts such as development states and geographies with immense inequality in terms of access to infrastructure.

Third, research on sustainable energy transitions has not traditionally focused on the role of social contracts in the formation and reconfiguration of socio-technical regimes. Cases exploring regime change in large technical systems commonly view the stabilisation of socio-technical regimes as driven by quasi-evolutionary, competitive dynamics that are detached from consensus-building and cooperation amongst social groupings. In contrast, this chapter highlighted the presence of a fragile but effective social compact between diverse social groupings in relation to the City's electricity regime. This enables a (re)framing of network infrastructure as systems constituted from underlying social contracts between different social groupings. In the City, many stakeholders argue that in the configuration and operation of networks, stakeholders forfeit a degree of control and benefit, highlighted through the example of net-metering, from network infrastructure in favour of wider

‘public goods’. Through such a lens, reconfigurations (or transitions) of infrastructure regimes are seen as a process of re-negotiating the social contract between different social groupings in response to landscape pressures that are forcing change.

### 5.3.3. (Re)framing socio-technical reconfigurations as value tensions

The City’s electricity regime is currently structured around a set of values that may broadly be defined as developmental values. However, as highlighted, these values and the public goods entrenched in network infrastructure may be disrupted by green niche innovations in particular and regime reconfigurations based on environmental values. Thus, in the City’s case, environmental values compete with developmental values embedded and integrated within the regime structure. These tensions are both systemic in nature and contested in reconfiguration policy agendas.

Systemic value tensions relate to the deep structure of a socio-technical regime. In the City of CT’s case, for instance, it was highlighted that reconfigurations based on environmental values can cause fissures in the regime related to reproduction of development values such as collapsing a business model that services the poor or disrupt redistribution, affordability and pro-poor service delivery through facilitating a system based on energy autonomy and privatisation (inverse values).

Value tensions in ‘reconfiguration policy agendas’ (or policy value tensions) are manifest in several ways. First, reconfigurations based on environmental values (hereinafter referred to as environmental reconfigurations) may compete with and usurp budget and resources that would otherwise be spent on development objectives. Second, environmental reconfigurations may increase the cost of infrastructure or development services to the poor. Third, environmental reconfigurations disrupt or hinder service delivery to the poor. Fourth, environmental reconfigurations may facilitate the provision of differentiated services to different user categories and thus increase inequality and splintered urbanism (Jaglin, 2008; Monstadt, 2009; Satterwaite, 2007). Fifth, regulation and taxes aimed at facilitating environmental reconfigurations may be regressive in that they disproportionately affect the poor.

In brief, this chapter illustrates that different regime values may be oppositional and create tensions during regime reconfiguration processes. Notably, entrenched regime values may be threatened with the introduction of new regime values. These tensions are both systemic in nature and are manifested in reconfiguration policy agendas. Whereas the former relates to tensions that occur as a result of the way in which regimes are structured, the latter occurs due to competing policy agendas. This provides a fresh conceptualisation of regimes as a set of contested values that compete with each other during configuration and reconfiguration processes. This to some extent blends the MLP with a Hegelian-Gramscian (1932) perspective on transitions by conceptualising

socio-technical regimes as systems produced and reproduced through contested 'hegemony and ideology'.

#### 5.3.4. Biases in the policy and practice of sustainable transitions

Exploring a socio-technical regime in the Global South highlights certain biases common in the policy and practices of sustainable energy transitions; related to both focus and the definition of sustainability. First, this chapter underscores the 'technological bias' and techno-optimism tendencies prevalent in Global North sustainable energy policy. Meadowcroft (2009) critiques the narrow emphasis in sustainability and climate policy and practice to present the replacement of one technological system with another as a fix-all solution to sustainability challenges. Huesemann and Huesemann (2011) argue further that technologies and their application inherently have unintended consequences. This chapter highlights such unintended implications of the replacement of systems of supply, but in relation to a socio-technical regime. SSEG or distributed generation is typically described as the sustainable replacement of a system of supply as a means of achieving a sustainable energy transition. However, in the City's case, it was demonstrated that distributed generation would potentially collapse a socio-technical regime comprised of multiple sub-systems including cross-subsidy systems, and hence compromise the entire municipal business model. This highlights that behaviour and dynamics in complex systems are difficult to understand and predict. In brief, supply substitution and technical fixes may in fact have detrimental consequences for the sustainability of transitions.

Second, this chapter emphasises the 'Global North bias' in sustainability policy and practice. Notably, the example of net-metering highlights the implications when transition tools and initiatives originating in the Global North are applied in Global South contexts. This reiterates a common critique of best practice and technology transfer (Patel et al., 2015; Brent and Kruger, 2008) but applies and assesses the implications of best practice to a regime as a complex system. This application provides a number of insights. First, it is apparent that regime value tensions become particularly acute when transition tools that are rooted in contexts where specific regime values are prioritised are indiscriminately used in contexts where different regime values are prioritised. This further emphasises critiques on technocracy and the primacy of 'expert knowledge' (Fischer and Fiorino, 2014) in relation to sustainable transition policy. Second, it is evident that the direct transfer of transition tools from the Global North to South would tend to benefit the wealthy at the expense of the urban poor, resulting in a reproduction of the incumbent 'political economy'. There are moreover indications that disruptive niche innovations in general may have a proclivity to reproduce and enhance incumbent socio-economic patterns and political economies in the

Global South, due to the particular function of regimes in redistribution and reducing inequality. Third, this chapter demonstrates that specific techno-economic configurations lend themselves to specific regime values sets. SSEG and net-metering lends itself to devolution of power and autonomy, but also reinforces a system based on privatisation, deregulation and neo-liberal ideals of individualism. In other words, SSEG and net-metering, in a city of the Global South, appear to have socio-political prejudices inherent in them. Such insights reinforce a conceptualisation of socio-technical regimes more attuned with political ecology and a social constructionist view of technology (Genus and Coles, 2008).

Third, the case highlights the inherent 'green bias' in sustainable energy policy and practice to the exclusion of social sustainability (Shove and Walker, 2007a). In policy and practice, sustainable energy transitions are commonly achieved through the replacement of traditional systems of supply with a more environmentally friendly. This conceptualisation is aligned with the policy priorities of the Global North. In response, this chapter highlighted the underlying structural constraints to social transitions including the role of privatisation and deregulation in creating inequalities and unsustainable outcomes. Further, this chapter used the example of electrification to highlight that transition initiatives, based solely on social criteria, would also qualify as a transition. This was done in order to widen the lens of enquiry to transitions 'with important social aspects' (Rip and Kemp 1998). It thus is evident that innovative government policy responses, technological innovations with social sustainability benefits as well as innovations arising from challenges in the informal sector provide interesting cases of innovation that may disrupt an incumbent regime. This is particularly relevant to the Global South where social sustainability is a greater policy priority in regime reconfigurations. Conversely, although it has been argued that innovation that achieves social criteria may qualify as a sustainable transition, a focus solely on social dimensions would be equally open to scrutiny. The example of electrification, for instance, would have similar limitations as it would negatively impact on environmental criteria of a sustainable reconfiguration. This accordingly calls for an integrated framework for identifying and analysing sustainable energy transitions<sup>67</sup>.

In brief, this chapter explicitly identifies three biases in sustainable transition policy, practice and research related to technology, Global North and environmental sustainability and the resultant predisposition towards best practice and technology transfer. In making these biases explicit, this chapter provides an argument for a more context-specific approach to investigating, contextualising and understanding socio-technical reconfigurations that considers geographies

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<sup>67</sup> See Section 5.3.5

with different priorities in relation to socio-technical regimes, social dimensions of transitions and the limitations and perils of technology in general and supply substitution as a means of achieving sustainable transitions in particular. This approach is particularly relevant to the Global South, where systems of supply are embedded in centralised networks developed with a range of underlying development values in mind whereby green niche innovations may disrupt systems of cost sharing and redistribution.

### 5.3.5. Framework for exploring contested sustainabilities in transitions

Several authors have critiqued the underlying conceptualisation and criteria of sustainability adopted in sustainable transition case selection and theory (Shove and Walker, 2007a), and the over-emphasis on financial efficiency (Smith et al., 2013) and environmental considerations. Notably, Silver and Marvin (2016) stress the presence of ‘contested transitions’ in relation to African urban energy regimes. This chapter finds that such contestations largely surround conceptualisations and criteria of ‘sustainability’.

In the City’s case a number of regime policy reconfiguration agendas were identified. These roughly coincide with the four dimensions of sustainability i.e. environmental, social, economic and governance. First, the City of CT has established a social reconfiguration agenda that incorporates a range of criteria and indicators of the social dimension of transitions. These include a focus on poverty alleviation, redistribution, inequality, marginalisation, access and affordability, social needs, social welfare and justice. The identification of reconfigurations based on aspects of social sustainability due to the prominence of social considerations in infrastructure transitions in the Global South. Second, the City’s environmental reconfiguration agenda explicitly incorporates a range of criteria and indicators for measuring environmental sustainability. These include renewable energy, energy efficiency, electricity consumption reduction and climate mitigation. Although environmental sustainability has been fleshed out more in sustainable transition case selection and theory, researchers nevertheless tend to adopt a narrow and vague conceptualisation of environmental sustainability (Genus and Coles, 2010). The City’s case, to some extent, demonstrates a broader definition of environmental performance.

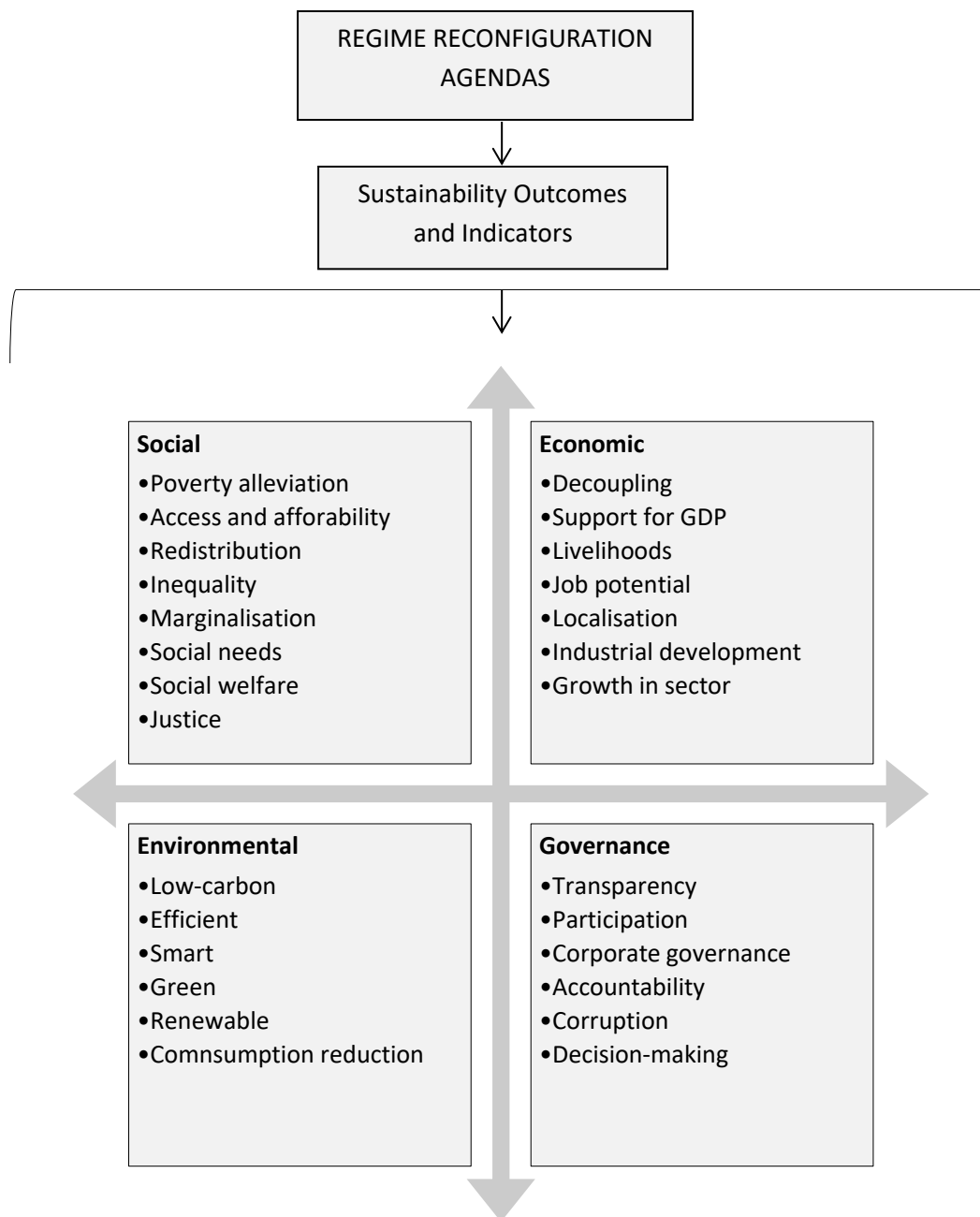
Third, a range of economic criteria for sustainability may be extrapolated from the City’s infrastructure and economic policy and goals. These include resource decoupling<sup>68</sup>, internalising costs, livelihoods and improvements in quality of life, consideration of labour intensity, job potentials and economic opportunities, economic localisation, development and well-being and industrial development in both incumbent and potentially reconfigured socio-technical systems. On

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<sup>68</sup> Decoupling consumption from economic growth

the contrary, apart from a focus on financial feasibility and the market-based underpinning of the MLP (Shove and Walker, 2007a) economic aspects of sustainability are also ill-defined in sustainable transition studies. Further, numerous governance-related aspects of sustainability are manifest in relation to the City of CT's electricity regime and reconfiguration agendas. These include issues of transparency, accountability and corporate governance of institutions involved in network infrastructure. From the above a multi-criteria framework that adequately addresses the four pillars (economic, environmental, social and governance) and concomitant indicators of 'sustainable' transitions may be inferred. This is represented in Figure 5.15.

*Figure 5.15: Multi-criteria framework for evaluating sustainable transitions*

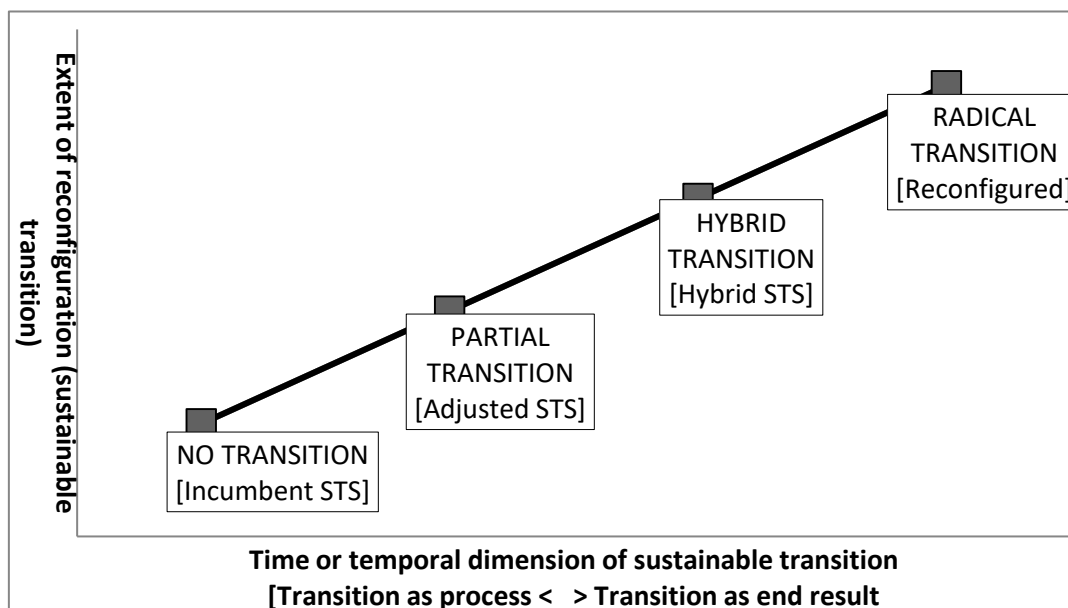




Specifically, this chapter highlighted that several competing reconfiguration processes have been initiated in relation to the City's electricity regime. This has resulted in a range of nascent interventions and niches being incorporated into the incumbent regime. These interventions are at different stages of diffusion and adoption. Thus, due to contested policy agendas, a hybrid regime that achieves a mixture of sustainability indicators (economic, environmental, social and governance), to varying degrees, is emerging.<sup>69</sup> This provides a basis for categorising transitions according to the extent of change or reconfiguration of the regime. This correspondingly may inform a sustainability framework that incorporates the process or temporal scales of transitions. In brief, it is possible to classify transitions in terms of: no transition, partial transition, hybrid transition, or 'radical transition'. Only the latter could be regarded as a fully 'transitioned' or reconfigured socio-technical system with a completely different structure and function. This classification offers a mechanism to clearly define the extent of reconfiguration of a socio-technical regime under study.

A temporal axis is useful in the assessment of long-term processes of change. This responds to a critique by Shove and Walker (2007a) that sustainable transition cases are often vague and unclear as to what constitutes a 'transitioned' socio-technical system. A temporal dimension can further enable a distinction between sustainable transitions as a process of becoming or an end result. Figure 5.16 provides a diagrammatic representation of the temporal dimensions of sustainable reconfigurations.

*Figure 5.16: Temporal dimensions of sustainable reconfigurations*



<sup>69</sup> Further, in previous sections the presence of hybrid regime features were identified in relation to mixed institutional features, i.e. competitive versus state-owned monopolies (Eberhard 2010) and informal and formal socio-technical structures.

The above framework provides a more robust conceptualisation of sustainability for exploring transitions; in terms of process, timeframes, criteria and indicators. Notably, it enables a more explicit identification of the pillars and criteria of sustainability that are primarily being investigated or are manifest within specific transition cases or contexts. This to some extent reconciles sustainable transitions with more integrated conceptualisations of sustainability including 'Just Sustainabilities' (Agyeman et al., 2013) and 'Just Transitions' (Swilling and Anneck, 2012). The above framework further integrates indicators such as *inter alia* social sustainability (Genus and Coles, 2008), improvement in quality of life, well-being, livelihoods, justice and equity, control and ownership over resources (Schlosberg, 2012a; Lawhon and Murphy, 2011), and development and economic opportunity into a transitions paradigm.

Exploring the City's electricity regime illustrates that the framing and criteria of sustainability, in relation to socio-technical transitions, are contested and contextual. Thus, a broadened conceptualisation of 'sustainable' transitions is particularly important for applying a transitions and STS framework in diverse contexts, where different dimensions of sustainability are prioritised and manifest in transition processes. A robust sustainability conceptualisation thus has general application as a framework to evaluate sustainable transitions in other contexts.

#### 5.3.6. Urban transitions and justice across scales

This chapter contributes to debate on the 'patchiness' (Coenen and Truffer, 2012) of transition progress. As indicated, centralised (nationally bounded) grid infrastructure facilitates the capacity of developmental states (national government) to administer a basket of public goods and services as well as enabling allocation of cost and benefit across a larger user-base, on a national level. Notably, post-colonial infrastructure reconfigurations have largely concentrated on facilitating national-level redistribution, cross-subsidies and provision of infrastructure access and service delivery to the poor. Thus, post-colonial reconfigurations have predominantly focused on restructuring or extending infrastructure to historically marginalised groups (or different political economies). Accordingly, it may be argued that national socio-technical infrastructure regimes are intended to reduce 'patchiness' across cities and regions.

On the other hand, it has been shown that urban transition, based on urban autonomy, may disrupt and reduce this capacity of cost-sharing across a wider user base and may have negative socio-economic implications on national development transitions. Decentralised urban transitions, without alignment with national 'development' transitions (Hodson and Marvin, 2010) may enhance enclaves of 'green and smart cities' surrounded by regions of infrastructure poverty. In

brief, transition processes have costs attached to them. Urban transitions may in fact be partly responsible for the presence of 'patchiness' (Coenen and Truffer, 2012). Phrased differently, urban transitions may enhance regime value tensions at larger scales. This consequently challenges the narrative of urban ecological security (Hodson and Marvin, 2009a), self-reliance and urban resource and infrastructure autonomy and securitisation, which underpin the practice of urban transitions. Importantly, it highlights that urban transitions result in bounding, limiting and protecting the interests of urban citizens at the expense of regional or national interests or poorer urban areas. This has particular relevance to Global South contexts with significant patchiness in terms of development, particularly in respect of the urban-rural divide and between cities.

As such, it has been demonstrated that configurations of social interests on the urban scale can indeed influence national transitions (Hodson and Marvin, 2010). However, the above brings new questions to the fore in relation to the implications of urban transitions including; in what ways, if any, do urban transitions negatively impact, limit or constrain national transitions? What is the impact of urban bounded transitions on regions and poorer cities that depend on inter-city cross-subsidies and redistribution in relation to infrastructure? In defining transitions along urban boundaries, who is excluded from the benefits of reconfiguration processes? These questions are particularly relevant in relation to the capacity of wealthier cities to coordinate and mobilise resources (Hodson and Marvin, 2010) for transitions at the expense of poorer regions and poorer cities.

#### 5.4. Conclusion

This chapter, based on critiques by Silver and Marvin (2016), Murphy (2015) and Lawhon and Murphy (2011) explored an infrastructure socio-technical regime in a developing, African city context. As anticipated, this provided fresh insights for transition theories in general and the notion of socio-technical regime in particular. First, identification of specificities of urban transitions (Silver and Marvin, 2016) in a Global South context supports a conceptualisation of hybrid regimes, infrastructure differentiation and cities as extensions of centralised networked socio-technical regimes. Further, the role of the state in public transitions, in the context of regulated and centralised developmental institutions, led to a differentiation of public- versus private-led transition processes.

Second, this chapter offered an alternative conceptualisation of regimes as systems of values (and hegemonies); referred to as regime values. In particular, it emphasised the role of infrastructure regimes in facilitating public goods and identified the underlying social contracts that underpin these regimes. In general, this chapter highlighted the extensive integration of developmental

values within a Global South socio-technical regime. Nevertheless, the integration of regime values into regimes (lock-in) is not limited to the Global South. Socio-technical regimes in different geographies would be underpinned by unique histories and contexts where different regime values are prioritised and enmeshed within regime structures.

This chapter illustrated that different regime value sets may compete and negatively interact with one another. These regime value tensions and contestations are both systemic in nature and are manifested in reconfiguration or transition policy agendas. In particular, this chapter highlighted the tensions between public network infrastructure (and associated development values) on the one hand and private green niche 'disruptions' on the other. This supports a conceptualisation of socio-technical regimes as sites in which different sets of regime values, which may be opposing and contested, are integrated (locked-in). Such a conceptualisation integrates learnings from conflict theories (Genus and Coles, 2008; Lawhon and Murphy, 2011) with the notion of socio-technical regimes and transitions.

Further, this chapter identified and discussed a range of biases in sustainability policy and practice that are evident when exploring sustainable transitions in a Global South context. These relate to a technical and 'green' preconception that stems from the Global North origins of sustainable energy transition policy and practice. Due to the Global North influence on sustainable energy policy, sustainable energy transitions are implicitly defined in terms of environmental values. In response, this chapter discussed and offered a framework to explore 'sustainable' transitions in diverse contexts, particularly Global South geographies where conditions such as poverty, inequality and marginalisation are prevalent in respect of network infrastructure.

Finally, this chapter provided the basis for a critique of the urban resource securitisation narrative common in urban transition analysis. It found that there is not only 'spatial patchiness' (Coenen and Truffer, 2012) in relation to progress in transitions, but rather urban transitions in the Global South enhance such patchiness. Notably, the tensions between the developmental state with nationally-bounded infrastructure policy priorities and urban green transition agendas were explored. In this regard, it was found that urban transitions based solely on environmental values may potentially disrupt national regimes (and underlying social contracts) structured to administer public good and share and distribute resources along national boundaries.

## Chapter 6: Transition pathways and typologies in the Global South

### 6.1. Introduction

The preceding chapter focused mainly on incumbent socio-technical regimes (static) and contestation within regime structure, function and policy agendas. The aim of this chapter is to examine regime reconfigurations (change) in cities in the Global South with a particular focus on conditions, pathways and governance of reconfigurations. Hence, this chapter is situated within debates on the conditions under which socio-technical regimes change (Smith and Stirling, 2010; Geels, 2004); potential pathways and typologies of reconfigurations (Geels, 2007; Berkhout et al., 2004) and the management or governance of transitions (Smith and Stirling, 2008) through an urban Global South lens.

First, this chapter seeks to contribute to debate related to the conditions that make reconfigurations possible (Geels, 2002; Smith, 2007b) with a focus on the role of networks, civil society and interest groups (Genus and Coles, 2008) and interactions between the state, civil society and the private sector in facilitating reconfigurations. This builds on the framing developed in the preceding chapter of regimes as contested values. This enquiry is empirically explored through an historical account of the Cape Town's electricity regime, classified according to four periods in terms of distinctive regime characteristics; and identifying the factors, processes and stakeholders that contributed to successive reconfigurations.

Second, this chapter examines the value of a constructivist approach to exploring socio-technical reconfigurations in the Global South (Shove and Walker, 2010; Kaghan and Bowker, 2001). This is empirically explored through identifying two broad energy trajectories that the City of CT is able to pursue; a centralised or distributed trajectory and examining the outcomes of these divergent trajectories vis-à-vis socio-economic impact, access and equity. This informs a heuristic to examine the socio-economic outcomes of reconfigurations in the context of 'multiple development pathways' (Bijker, 1995; Meadowcroft, 2008) in contrast to the ecological modernism and technological determinism inherent in several sustainable transition frameworks including innovation studies, transition management and broader sustainability science.

Third, this chapter seeks to expand on the classification of transformation typologies, developed by Geels (2007) and Berkhout et al. (2004), in two ways. It seeks first to explore the conditions under which regimes may rapidly unravel and the associated socio-economic ramifications. This attempts to fuse reconfiguration typologies with concepts stemming from both conflict theory and dynamic

systems theory. Further, it seeks to explore reconfigurations in conditions present in Global South contexts vis-à-vis infrastructure inequality, poverty and marginalisation. This is done through identifying the onset of potential reconfiguration processes in the City, which in turn inform alternative theoretical reconfiguration typologies. This builds on the preceding chapter, which identifies tensions between environmental and development values embedded in regimes, and explores the logical outcome of these tensions in reconfigurations.

Finally, this chapter seeks to explore the governance of socio-technical reconfigurations in relation to nested scales (multi-level governance) alongside issues of representation and exclusion. This theme is explored by describing modes of governance, adopted by an urban climate network, aimed at transforming the City's electricity regime. This informs a critique on 'reflexive governance' frameworks adopted in the Global North and highlights the value of considering power, representation and exclusion in theorising on the governance of socio-technical reconfigurations in cities in the Global South.

## 6.2. Results

### 6.2.1. Historical configuration and reconfigurations in Cape Town

There have been a number of distinct periods in which widespread change in the City of CT's electricity regime occurred. Four periods are distinguishable in terms of unique regime characteristics. These periods are discussed in relation to their main features or characteristics; interactions between the state and private sector (niche firms); regime values that underpinned these periods; stakeholders, factors and processes that resulted in reconfigurations; the interest groups that benefited from particular configurations; and regulatory enforcement. These provide compelling cases in which to extrapolate the conditions that make change in socio-technical regimes possible.

#### a) The initial configuration (1879 - 1912)

An invaluable record for understanding the initial configuration of the City's electricity regime is provided by Palser (1995) in a historical account of the development of the electricity supply industry in Cape Town called 'Lighting up the Fairest Cape'. Overall, the initial configuration of Cape Town's electricity regime can be characterised by experimentation. Interactions between the state and 'niche firms' were fluid during this time whereby a mix of municipal, private and hybrid public-private arrangements participated in electricity generation and distribution. For example, the first electric lights in Cape Town were installed through an agreement between the City<sup>70</sup> and a private

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<sup>70</sup> Under the government of the Cape Colony.

enterprise<sup>71</sup> to fit, maintain and guarantee the electric lights. This is an example of a rudimentary performance contract. Notably, from the completion of the first private power station<sup>72</sup> until the turn of the century, electricity was supplied and distributed by a mishmash of private and municipal entities and public-private partnerships.

During this period the City had a central role to play in incubating and mainstreaming electricity 'niches' or innovations of the time. For instance, the City led the conversion (or transition) from direct current machines<sup>73</sup> to alternating current machines<sup>74</sup> (Palser, 1995). This modified the entire electricity sector in Cape Town by mainstreaming the use of alternators. Notably, the invention of the steam turbine in 1892, alongside the adoption of alternators, resulted in a turbo-alternator set which revolutionised electricity generation. This 'revolution' was recognised by the City and it promptly adopted steam turbine technology in all new power stations and extensions. This 'early adoption' facilitated the future 'lock-in' of steam-turbine technology. Thus, the initial configuration of the City's electricity regime emerged through collaborative processes between technology developers, the private sector and local government.

During this period the electricity industry in Cape Town was regulated by a range of diverse and sometimes conflicting decrees, edicts and contracts. Despite regulatory uncertainty, these rules provided scope for innovation and experimentation. However, the values that underpinned this initial regime configuration were knotty. Although this configuration was shaped through relatively open values in terms of flexibility and collaboration, it established a segregated, exclusionary and discriminatory service delivery structure that lasted a century (Eberhard, 2010). Thus, the only interest groups that benefited from this structure were corporates, the state and citizens of the Cape Colony, to the exclusion and detriment of all others.

#### b) Reconfiguration for control and segregation (1912-1994)

The main dynamic that unravelled the above configuration (1879-1912) was the formation of the Union of South Africa (1910) and the rise of the apartheid government that reconfigured infrastructure systems from the top-down. The main characteristics of this period in relation to the electricity regime were centralisation and monopolisation (Eberhard, 2010). The interactions between the state and niches during this period were likewise characterised by consolidation of power. In Cape Town the above-mentioned multiplicity of municipal, private and hybrid distributors

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<sup>71</sup> Brush Electric Light and Power Company.

<sup>72</sup> 1892

<sup>73</sup> Dynamos

<sup>74</sup> Alternators

began being replaced by a centralised (dominant) Electricity Supply Commission [later became Eskom] and a consolidation of City of Cape Town -owned stations.

In 1913 the City of CT council began acquiring generation and distribution assets of various private companies and successively dismantling private power stations.<sup>75</sup> Parallel, between 1920 and 1922 the Union Government began a process of centralising the entire electricity industry. The Electricity Act, 1922 formally established the Electricity Supply Commission (ESC) and provided it with almost complete control over electricity generation and distribution throughout South Africa including control over all existing generation and distribution facilities.

Thereinafter, the City had marginal control, independence and autonomy related to electricity supply, which became concentrated at the national level. Shortly after the establishment of Eskom, several Cape Town power stations were decommissioned and shut down. From then on municipalities had to apply for licensing agreements to continue with existing generation and distribution facilities. Almost all future generation facilities in Cape Town were developed and financed solely by Eskom (Palser, 2010).

By the 1960s Eskom instructed that all future electricity supply to Cape Town would be generated in the Limpopo and Mpumalanga power generation region. This initiated the process of connecting Cape Town through an extensive transmission system that cut across South Africa. By the end of 1970s Eskom had fully established and connected the national transmission grid. This resulted in Cape Town being completely reliant on Eskom power and being locked into a mid-term future of centralised coal-fired electricity generation.

It is unmistakable that the values that underpinned this regime configuration mirrored the values of apartheid including segregation, control, domination, coercion and brutality. According to Eberhard (2010) apartheid energy policy was informed by two main threads; the provision of cheap energy for mining and primary industry and energy security for the apartheid state. Thus, the main interest groups that benefited from this configuration were corporate interests and the state.

### c) Reconfiguration for development and justice (1994 onwards)

The predominant dynamic resulting in the collapse of the above configuration was the fall of apartheid. In brief, the restructuring of the City's electricity regime was caused by both bottom-up (political activism) and top-down (democratic change) pressures. Büscher et al. (2009) highlight that political dissent towards state-owned enterprises, notably infrastructure regimes, became highly visible in the 1980s alongside broad opposition and political pressure against apartheid. According

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<sup>75</sup> Parallel to the promulgation of various pieces of oppressive apartheid regulation such as the Natives Land Act, 1913



to Krupa and Burch (2011) criticism towards Eskom's poor financial management preceded broader dissent against the gross injustice that the majority of South African's lacked access to basic electricity services.

Equally, in Cape Town, a network of activists, researchers and NGOs including the Development Action Group (DAG), the Institute for Democracy in South Africa (IDASA) and the Energy and Development Research Centre (EDRC) were engaged in condemning the incumbent electricity regime on the grounds of mass injustice (DAG, 2012). The process of reconfiguration of the City of CT's electricity regime thus mirrored the monumental social, political, legal, cultural and economic shift that occurred during South Africa's democratic revolution.

Following the collapse of apartheid and its associated electricity regime, sweeping reform occurred in the energy sector underpinned by vastly different value systems. As highlighted by Prasad (2008) the White Paper on Energy Policy (DME, 1998) sought to redress historical inequalities by pursuing universal access to energy and ensuring accessible, affordable and reliable energy for the poor. Thus, development, poverty alleviation, redistribution and universal access to affordable electricity and energy services henceforth underpinned energy policy in South Africa.

These values were entrenched in a suite of regulatory instruments, such as the Integrated National Electrification Programme (DOE, 2005); the Free Basic Electricity Policy (DME, 2003b); and the Electricity Pricing Policy (DME, 2004). Local government was delegated widespread duties in executing these policies and programmes. This provided the political and regulatory framework (landscape pressure) for the City to restructure its electricity regime and to henceforth prioritise energy poverty alleviation, electrification and energy service provision<sup>76</sup>. Correspondingly, in 2000 the Unicity was established after almost a decade of local government restructuring. This resulted in the consolidation and rationalisation of five separate electricity departments (CCT, 2010c). The major underlying rationale for restructuring local government, the City of CT included, was the extension of infrastructure services to the previously disadvantaged (CCT, 2009c).

Thus, the intended beneficiaries of this reconfiguration were citizens in general and the poor and marginalised in particular. Nevertheless, several features of the previous electricity configuration were retained, in some form, in the new regime structure, including centralisation, reliance on fossil fuels, spatial disconnects between generation and consumption and the sustenance of the mineral-energy complex.

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<sup>76</sup> See Section 5.2.4

#### d) Reconfiguration for environmental sustainability (1998 onwards)

As shown in the preceding chapter, the City is currently in the process of reconfiguring its electricity regime based on environmental values). A diverse set of stakeholders have facilitated this process. In particular, a loose network<sup>77</sup> of NGOs, researchers and City pioneers lobbied for ‘over a decade for a more low carbon, efficient and renewable urban electricity system’ (Interview 5. 11 April 2012). These organisations were ‘central in bringing energy security and climate change to the attention of City politicians and top management’ (Interview 23. 26 August 2012). It is evident that NGOs and researchers played an important role as ‘intermediaries’ (Moss et al., 2010) between separate City departments, between officials and politicians and across spheres of government. In this regard the Head of Energy and Climate Change said:

In this space the values of a mediator is [sic] crucial. In the ECAP process, Sustainable Energy Africa played a critical mediation role between the University and the City and between ERMD and the Electricity Department (Interview 23. 26 August 2012).

Involvement in incubation programmes has also been central to this process. In particular, the City’s participation in the DANIDA-funded Sustainable Energy for Environment and Development (SEED) Programme<sup>78</sup> played an influential role in kick-starting sustainable energy planning. According to a member of Sustainable Energy Africa involved in SEED, the City of CT was the most ‘successful municipality in the programme due to the presence of a champion’ (Interview 5. 11 April 2012). This culminated in a City Energy Strategies Conference<sup>79</sup> which eventually led to the adoption of the Energy and Climate Strategy (CCT, 2006d).

By 2008 the City had recognised the importance of energy security and climate mitigation evident by its inclusion in the Integrated Development Plan (CCT, 2009c). However, in the same year Cape Town experienced major rolling black-outs and load-shedding as a result of a national supply crisis. In response the City Mayor committed, based on bottom-up pressure, to set up a dedicated institutional structure to implement the Energy and Climate Strategy, with a focus on energy security (CCT, 2009a). This led to the establishment of an Energy Committee<sup>80</sup>, an EMT Sub-committee on Energy and Climate<sup>81</sup> and three administrative work streams to facilitate transversal implementation of the Strategy (CCT, 2010a). According to the Head of Energy and Climate Change these structures placed energy and climate directly on Council’s agenda and provided ERMD with an opportunity to regularly influence politicians (Interview 23. 26 August 2012).

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<sup>77</sup> See Section 6.2.4

<sup>78</sup> 1998-2006

<sup>79</sup> Hosted in 2000

<sup>80</sup> Political

<sup>81</sup> Administrative

The Energy Committee subsequently instructed the development of the ECAP to operationalise the Strategy (CCT, 2010a). This resulted in a process of identifying ‘reconfiguration’ objectives and targets, consolidating and up-scaling initiatives that were already being implemented and launching new projects and programmes. The ECAP process thus provided a tool to mobilise and coordinate resources.

Overall, collaboration between NGOs, the research community and City of CT officials has resulted in raising awareness (articulation of selection pressures), fostering knowledge, the development of policy to re-orient the City’s electricity regime and developing institutional structures and capacity for managing such a reconfiguration process (CCT, 2011b).

Notably, since 2012 Eskom has confronted a major financial and supply crisis characterised by periods of rolling black outs and load shedding associated with insufficient long-term planning, poor financial management and rising debt (Burton and Winkler, 2014). This has resulted in a re-negotiation of regulation and power dynamics between national government and the City in relation to energy autonomy<sup>82</sup>. However, it is only since the risk of revenue loss has become visible that the Utilities and Finance Directorates’ have entertained the possibility of alternative socio-technical configurations (Interview 16. 16 September 2013). Thus, as a result of threats to the City’s core business model, radically different utility and revenue models are being openly considered and debated. This openness for alternatives is evident in a several engagements between the Electricity Department, ERMD and Sustainable Energy Africa (Meeting 81. Electricity Department. 05 July 2013). Thus, the risk of regime collapse has opened up space for potential alternative configurations to take root.

### 6.2.2. Intersection of multiple trajectories and socio-technical outcomes

It is evident that there are multiple potential energy trajectories the City could pursue. In the preceding chapter a proposed ‘environmental reconfiguration agenda’ and a ‘development reconfiguration agenda’ were outlined<sup>83</sup>. There are several further competing ‘energy visions’ framed in various City policies that are distinguishable. For instance, the Optimum Energy Future outlines three energy future scenarios including a business as usual, optimum energy future and a scenario in line with the National LTMS (SEA, 2015a). This section specifically interrogates two prominent ‘visions’ (Smith and Stirling, 2010), trajectories (Geels, 2002) or potentialities (Genus and Coles, 2008) related to the City’s electricity regime: a centralised-supply model on the one hand and a decentralised-demand model on the other. The City of CT appears to be at a crossroads

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<sup>82</sup> See Section 7.2.2

<sup>83</sup> See Section 5.2.4

between these two radically divergent pathways for reconfiguring its electricity regime. Either of these trajectories may find dominance in the City, which would have markedly different socio-economic, cultural, behavioural and political outcomes. Examining these trajectories thus enables an exploration of the socio-economic outcomes of transitions in relation to access, control, political economies and equity.

On the one hand, the City is developing policy and plans to pursue large-scale energy infrastructure, predominantly natural gas and an associated gas economy. This centralised-supply model is being driven by the City Executive Management Team and politicians, primarily for economic growth, energy autonomy and energy security reasons (CCT, 2011a). This plan is manifest in high-level policy documents such as the IDP, 2012-2017 (CCT, 2012a) and the City Economic Growth Strategy, 2013 (CCT, 2013d). A number of mechanisms are proposed to develop this energy infrastructure, including public-private partnerships, private incentives (such as offtake agreements), municipal-led development of Closed Cycle Gas Turbine plants and policy incentives to support local energy sector development (CCT, 2012a; CCT, 2011n). This plan is criticised and opposed by climate and energy-based NGOs and activists in Cape Town as well as nodes in the City. Apart from the fossil-fuel basis for such infrastructure, an underpinning critique by these actors relates to the socio-economic, political and cultural implications of such a techno-economic configuration. This critique is well summarised by a Programme Manager of the Electricity Governance Initiative:

A gas economy would be largely centralised. It would follow the top-down approach to infrastructure which has traditionally dominated. It would be like the national coal-electricity model - centralised, top-down, limited participation. This would reproduce the interests of the industrial-resource extractive complex. This model promotes jobless growth. It would also heavily undermine energy efficiency, demand-side management and behaviour change efforts (Interview 7. 30 September 2013).

In summary, the above highlights that such a technical configuration will have built-in 'political effects' in terms of beneficiaries (corporate and industrial), reinforcing the incumbent political economy, environmental implications and reproducing top-down command and control.

In contrast, climate and energy-based NGOs and activists in Cape Town are promoting a socio-technical configuration based on decentralised-demand energy infrastructure. This is evident from a range of documents including the 'State of Energy and Energy Futures Report' (CCT, 2011c). As highlighted by a report prepared for the Energy Committee, titled 'The role of the City of Cape Town in energy generation', such an energy configuration in Cape Town would support a vastly different socio-economic system based on distributed political power and decision-making (CCT, 2011i). Notably, energy efficiency and SSEG technologies are inherently labour intensive and provide local jobs in installation and manufacture (SEA, 2015a). This is evident by a study commissioned by the

Energy and Climate Change Unit that assesses the 'Developmental Impacts of the ECAP' (McDaid, 2011). The report highlights that energy efficiency, renewable energy and SSEG projects in the ECAP would result in a range of socio-economic benefits in terms of various indicators, particularly when compared to centralised generation. Further, the Optimum Energy Future (OEF) study (CCT, 2011c) highlights that a distributed technical configuration would provide various multiplying effects including the growth of technical support service industries. Importantly, the OEF study notes that energy efficiency and demand-side management tend to occur alongside cultural shifts whereby social value is placed on energy conservation and sustainability (CCT, 2011c). In brief, a decentralised-demand model requires innovation that is systemic in nature as it requires shifts in diverse social, regulatory, technical and economic contexts. Thus, in summation, the technical configuration of this trajectory would have different socio-economic outcomes in terms of beneficiaries (households and local businesses), distribution of power and decision-making and improved environmental performance. A report titled 'Energy Scenarios for Urban South Africa' highlights that it would result in a reorganisation based on a more bottom-up diffusion of control (SEA, 2015b). Conversely, the preceding chapter highlighted that such a model, in Global South contexts, contests with a more centralised, developmental energy model. As shown, it would also have negative implications in terms of access, redistribution of resources and energy-poverty alleviation. Although it would benefit new players, it would nevertheless, to a large extent, support and reinforce the incumbent political economy.

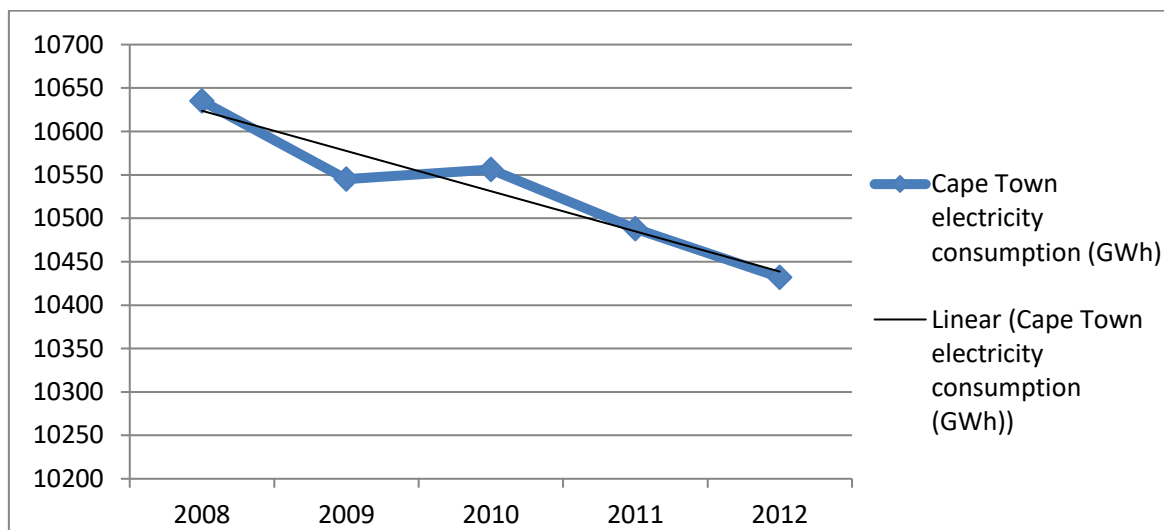
Notably, these two potential trajectories appear to be somewhat mutually exclusive. There is widespread evidence that cheap and abundant electricity undermines demand-side management, SSEG and energy efficiency (Eberhard, 2010; Burton and Winkler, 2014). Notably, Eberhard (2010) demonstrates the extent that a large generation expansion programme (over-supply) in the 1970s significantly undermined energy efficiency and DSM efforts. In brief, a centralised-supply model, and a 'gas economy' (CCT, 2011n) would potentially threaten an Optimum Energy Future (CCT, 2011a) as well as the service companies that have developed around energy efficiency and demand-side management policies and support instruments (CCT, 2015b). This was brought to the fore in a series of meetings between the Strategic Policy Unit and the Energy and Climate Change Unit in which these 'energy futures' were contested (Meeting 65. CCT Strategic Policy Unit. 12 April 2013).

### 6.2.3. Reconfiguration processes and dynamics in the City of Cape Town

The above section highlights the possibility of multiple potential reconfiguration trajectories that may result in radically different socio-economic outcomes. This section, on the other hand, provides examples of processes and dynamics occurring in the City that may potentially result in widespread and rapid system change. These highlight non-linear system dynamics rather than potentialities.

First, there is evidence of a potential ‘positive feedback loop’ arising from the City of CT’s response to technology change. As highlighted in the preceding chapter, a number of factors have resulted in reduced electricity consumption by middle and high electricity users and corresponding revenue impacts. In 2012 the City reported a 20% reduction of electricity consumption on a business-as-usual baseline (SEA, 2013a). As shown in Figure 6.1 electricity use is consistently below 2007 consumption levels (CCT, 2012).

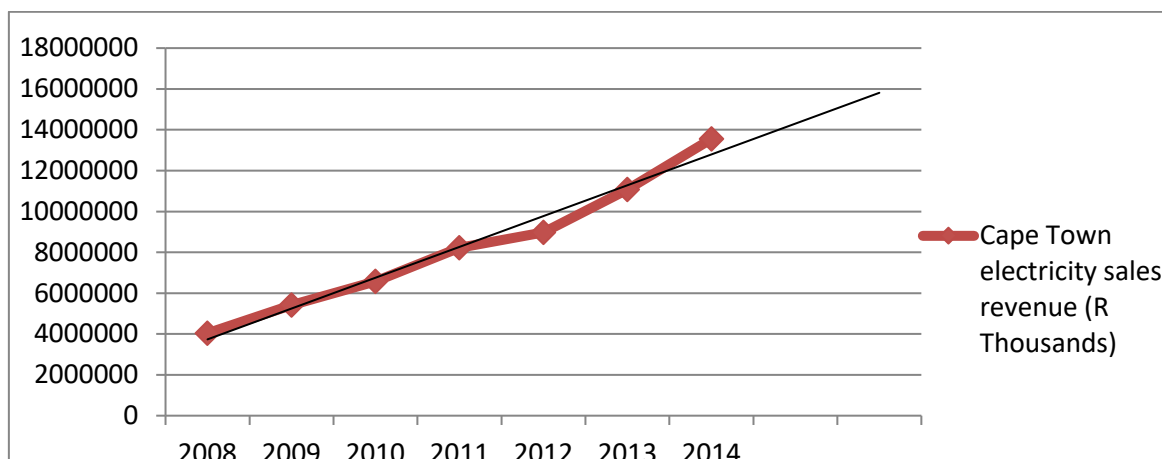
*Figure 6.1: Cape Town annual electricity consumption (GWh)*



Source: Raw bulk electricity data sourced from the Electricity Department SAP System (2008-2012)

Despite this shift, the City is budgeting and planning based on expectation of increased electricity revenue. This is evident from the Electricity Department Business Plan (CCT, 2011f) and the City Budget (CCT, 2012b). As highlighted in Figure 6.2, analysis of multi-year data from the Medium-Term Revenue and Expenditure Framework, 2012 (MTREF) (CCT, 2012b) indicates the City anticipates a steep upward trajectory of electricity revenue.

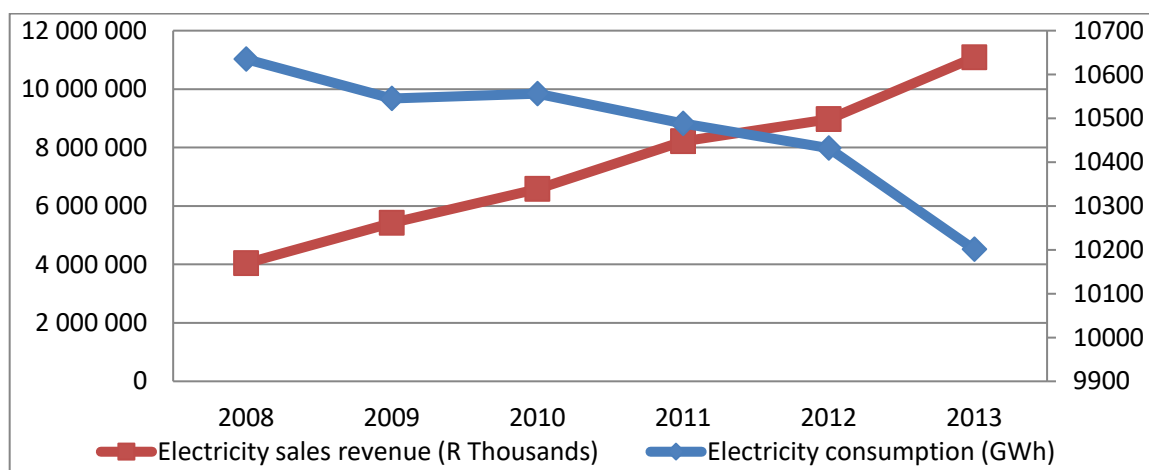
Figure 6.2: Annual electricity sales revenue (R Thousands)



Source: Raw data sourced from City of Cape Town Annual Budgets (2008-2014)

Thus, the City appears to be ‘articulating’ this selection pressure as a need to fill the revenue gap and is ‘responding’ by further increasing tariffs to middle and high electricity users<sup>84</sup>. However, this results in a further loop of energy efficiency and behaviour change by middle and high income households and businesses (Trollip et al., 2013). This creates a positive feedback loop that increases the problem the response was intended to solve. Figure 6.3 shows that at present there is an alignment between environmental and development values. On the one hand, electricity consumption is declining and efficient technologies are being adopted. On the other hand, revenue from electricity sales is increasing, which improves the City’s ability to meet development objectives.

Figure 6.3: Graph indicating reduced consumption alongside increased revenue from electricity sales



Source: Raw electricity consumption data sourced from Electricity Department SAP System (2008-2013) and raw revenue data sourced from City of Cape Town Annual Budgets (2008-2013).

<sup>84</sup> See Figure 5.12 and Section 5.2.3 for detailed evidence of impact of tariff increases on mid-high income households.

However, the trends of the above three graphs cannot continue in perpetuity. At some point, the revenue extracted from middle and high electricity users may motivate radical energy efficiency and off-grid options, potentially causing collapse in the business model (Laurent and Trollip, 2012; Janisch et al., 2012). According to the Head of Pricing and Regulation, if the City follows business-as-usual 'the current model will collapse in the next few years' (Interview 16. 16 September 2013). This statement highlights that a business-as-usual approach in response to complex landscape pressures enhances the possibility and magnitude of a positive feedback loop.

Second, signs of a potential 'cascading effect' arising from the City's response to non-technical losses are evident. In brief, the City of CT suffers from high non-technical losses, defined as 'non-payment of bills and electricity theft' (CCT, 2013a). According to the Head of Protection and Measurement:

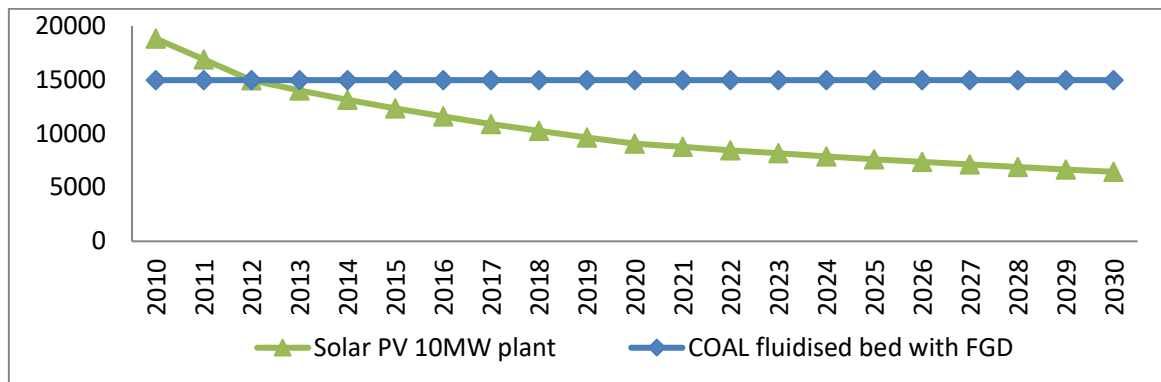
There is a massive cable theft problem and non-technical losses are rising rapidly. We cannot deploy enough staff to deal with theft and non-technical losses. This is the Electricity Department's primary metering concern (Interview 21. 16 September 2013).

Although the above statement reduces a complex socio-economic issue to theft, the inability to account for electricity use and theft nevertheless results in loss of up to 5% of total electricity revenue (CCT, 2013a). Several officials in the Electricity Department have internalised and 'articulated' this threat and propose a mass roll-out of smart meters to 'improve revenue collection and reduce non-technical losses' (CCT, 2012g; CCT, 2011f). However, smart meters improve energy management and consequently reduce revenue. Further, the Electricity Department aims to use smart meters to facilitate time-of-use pricing. This would stimulate further energy efficiency and behaviour change. Smart meters also enable bi-directional metering and SSEG feed-in which may result in further revenue impacts. Accordingly, a niche intervention, to address revenue loss, could potentially contribute to an incremental cascade of socio-technical changes that result in an adjustment to an incumbent electricity regime. In the language of the MLP, the Electricity Department proposes adopting a niche innovation to solve a local problem (Geels and Schot, 2010) which may result in cascading consequences for the entire regime.

Third, there is evidence that a 'tipping point' may be reached in Cape Town that could radically transform the incumbent electricity regime. In South Africa distributed energy is gradually becoming cheaper than the national blended grid (Laurent and Trollip, 2012; Janisch et al., 2012). The Integrated Resource Plan for Electricity (DOE, 2011e) forecast that small-scale solar PV will reach price parity with new coal power generation in coming years (Figure 6.4).



Figure 6.4: Official IRP 2010 cost projections of photo-voltaic compared to coal



Source: Integrated Resource Plan for Electricity 2010-2030 (DOE, 2011e).

Across the globe the levelised cost of electricity for distributed PV is declining rapidly (SEA, 2012b). Already, the City estimates that there are up to 1000 installed solar PV systems that are feeding into the grid (CCT, 2012d; CCT, 2012f). Further, as mentioned, the City plans to steadily increase electricity tariffs (MTREF, 2012) and the Multi-Year Price Determination, which determines national electricity price increases at five-year intervals, stipulates an 8% annual electricity tariff increase. Scenario planning by Trollip et al. (2012) highlights that the combined impacts of increased tariffs and the ‘decrease in the real price of PV systems’ could result in up to 100,000 Cape Town households in the Domestic 1 (high-end users) category installing PV for own-generation by 2021. Accordingly, a tipping point may be reached whereby price parity alongside rising grid prices results in widespread uptake of SSEG, forcing rapid change to City’s electricity regime.

#### 6.2.4. Transformation typologies and regime values

The above section describes typologies of rapid and non-linear change but does not investigate the social, economic and environmental manifestations of different transition scenarios. This section builds on the preceding chapter, related to tensions inherent in regimes between development and environmental values, by expanding these findings to an analysis of potential transformation scenarios and concomitant sustainability outcomes.

The first scenario is one in which the City undertakes an energy transition based solely on ‘environmental performance’. As shown in the previous chapter, the City depends on fiscal transfer from the rich to the poor in order to achieve development outcomes. In summary, a multiplicity of ‘landscape pressures’ are placing systemic limitations on the capacity of the City to achieve both development and environmental objectives of a sustainable transition. These include increasing tariffs to high-end users and increased uptake of energy efficiency and SSEG technologies coupled

with increased energy poverty and service needs as a result of rapid urbanisation, expansion of informal settlements and in-migration (CCT, 2012a; Laurent and Trollip, 2013).

Stemming from the above and the preceding chapter, it is possible to forecast a scenario whereby, supported by the City's energy reconfiguration plans, wealthy households and businesses transition to a 'low-carbon, smart and decentralised' (CCT, 2015b) electricity system. The transformation outcome would be a well-served, 'world-class' (CCT, 2015b; GreenCape, 2012) green electricity system for middle and high income residents and businesses. As shown, this would reduce the capacity of the City's electricity regime to support and service the poor. As reiterated by the Head of Pricing and Regulation, 'reduced revenue would result in the deterioration of energy services and indigent communities receiving even less support (Interview 16. 16 September 2013).

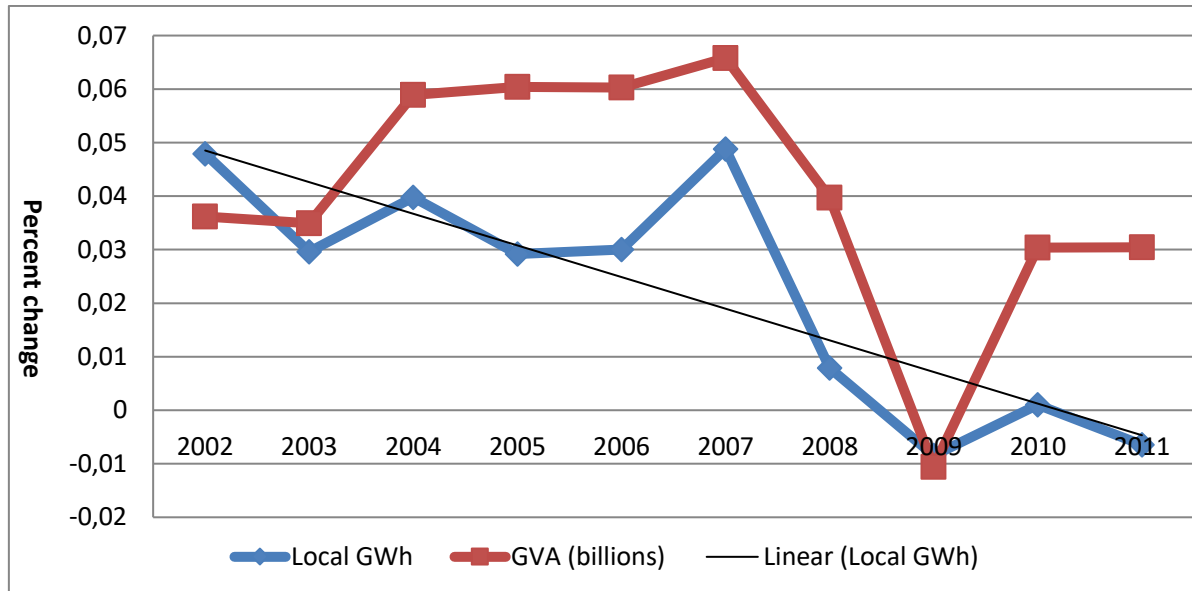
Thus, building on the results of the preceding chapter, it is evident that during reconfiguration processes these systemic tensions are amplified and manifest in highly splintered (Graham and Marvin, 2001), differentiated (Pieterse, 2008) and hybridised (Silver and Marvin, 2016) reconfigurations, that further exacerbate existing splintered infrastructure

The second, and equally plausible scenario is one in which the City manages an energy transition based solely on 'social sustainability'. In this example the municipality ramps up efforts at energy poverty alleviation and redistribution through increased cross-subsidies, electrification, energy service provision and increasing FBE allocations whilst simultaneously restricting energy efficiency, renewable energy and SSEG incentives and diffusion. In brief, the manifest political preference for energy poverty reconfiguration agendas alongside the extent to which policy-elites protect the incumbent regime logics could plausibly result in a scenario with reduced energy poverty and inequality in Cape Town. This would, correspondingly, result in reduced environmental sustainability.

A third scenario is one in which the City governs an energy transition that 'integrates' these potentially conflicting development and environmental tensions. There is evidence and advocacy for such an approach from a small number of officials, academics and NGOs such as the Electricity Governance Initiative. This, in essence, is advocacy for a 'Just Energy Transition' in Cape Town' (Swilling and De Wit, 2010). A potential indicator or concept that may be used to examine the extent to which the City's electricity reconfiguration balances development and environmental tensions is resource decoupling. In this regard, data provided by the Electricity Department alongside GDP figures was collected and analysed. As shown in Figure 6.5, Cape Town's electricity consumption, both total and per capita, has declined, dropping 20% below business as usual (CCT, 2015a) and

2013 consumption is well below 2007 levels (CCT, 2015a). At the same time Cape Town's GDP has increased. This indicates decoupling of electricity use from economic growth.<sup>85</sup>

*Figure 6.5: Cape Town electricity consumption (GWh) alongside annual gross value add (GVA) as an indicator of decoupling*



Source: Raw consumption data sourced from Electricity Department bulk purchase data on SAP System and GVA data sourced from IDP (2002-2012)

However, it is evident that balancing these tensions further requires disentangling lock-in or systemic conditions. This includes decoupling revenue from electricity sales in order to remove structural disincentives to support reducing consumption (Trollip et al., 2013). As echoed by the Head of Green Energy:

Our electricity sales revenue, the City's cash cow is disappearing anyway, with or without embedded generation. We need to change or figure out where the money is going to come from. We have to change our business and revenue model (Interview 11. 04 December 2012).

In this regard, City officials have identified a range of potential interventions for preventing revenue loss. These include 'decoupling the tariff' by establishing a fixed service charge and discontinuing consumption charges (Trollip et al., 2013; Laurent and Trollip, 2013); requesting larger fiscal transfers from national government to buffer revenue loss (NT, 2013d); or increasing rates or consumption charges for other services to fund the shortfall from reduced electricity sales (SEA, 2012b). Conversely, a number of activists and NGOs argue that an entirely different business model is needed to balance these systemic tensions. This entails completely restructuring the City's utility

<sup>85</sup> Measured as units of energy used per unit of GDP generated.

as an energy service provider and hence raising revenue through a range of innovative ways such as installation and maintenance of distributed energy (EGI, 2013). Nevertheless, this is contested and resisted. This is reiterated in a report by Sustainable Energy Africa:

Some external advocates for renewable energy call for municipalities to adopt a different financial model which does not place such a revenue raising burden on electricity sales, but however theoretically defensible; this is unrealistic even in the long-term, as it strikes at the heart of a deeply entrenched modus operandi and institutional structure within these entities (SEA, 2014b: 3).

This highlights that, in the City, there are multiple pathways for integrating and balancing inherent regime tensions during reconfiguration processes. However, it also highlights that transition scenarios are driven by contested visions of sustainability related to socio-technical infrastructure. The next section explores this further, through focusing on the manner and modes in which actors and networks attempt to govern or manage socio-technical reconfigurations.

#### 6.2.5. Governing change in a complex socio-economic landscape

In Cape Town there is a strong presence of urban policy networks of state and non-state actors that are driving a transition process based on climate and environmental agendas. It is comprised of nodes in local and provincial state institutions<sup>86</sup>; local NGOs such as Sustainable Energy Africa; sector development agencies such as GreenCape; academic and research institutions, notably the Energy Research Centre and international agencies such as ICLEI-Africa<sup>87</sup>. This network resembles a Type I form of multi-level governance (Hooghe and Marks, 2003) as it primarily mediates between traditional political spheres at the local, national and international level. A major reason and benefit of participation in this network, expressed by City officials, is that it enables them to traverse traditional government hierarchies.

Participation in this network results in a blurring and cross-pollination of roles, attitudes and allegiances. Interviewed officials in the Energy and Climate Change Unit expressed that they felt more closely aligned to this network than to other City departments. The Principal Engineer: Energy and Climate went so far as to say that the Energy and Climate Change Unit was 'an NGO that had been established in the City' (Interview 20. 23 August 2013). Both state (Energy and Climate Change Unit) and non-state actors (Sustainable Energy Africa) in this network have spent over a decade establishing relationships with 'likeminded units' and individuals across the City's administration,

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<sup>86</sup> Primarily the Energy and Climate Change Unit and Provincial Government Department of Environmental Affairs and Development Planning

<sup>87</sup> See Table 10.3: Organisations in Cape Town engaged in energy reconfiguration interventions in Appendix 5 for details on relevant organisations and their involvement in implementing transition interventions

which act as ‘nodes of support’. The value of these nodes is described by the Head of Energy and Climate Change:

It is highly useful to have support structures in various Departments which support sustainable energy development. We have supportive people in Transport Department, Electricity Department, Supply Chain Management and Legal Services (Interview 23. 26 August 2012).

Apart from relationship-building this network also manufactures these nodes by recruiting and ‘deploying’ supportive individuals across City departments<sup>88</sup>. This strategy was highlighted by participants in both the Energy and Climate Change Unit and Sustainable Energy Africa across multiple interviews.

This network employs a range of strategies and governance modalities to steer socio-technical change, which display manifold interactions with the ‘niche-regime-landscape’ hierarchy. Notably, it actively engages in niche incubation<sup>89</sup> by supporting and mainstreaming green innovations. This is done through a number of ways such as advocating for preference for niche innovations in supply chain policies through a Greening the Procurement Policy programme (CCT, 2015s); contracting energy service companies in municipal retrofits (CCT, 2011d); marketing niche innovations in behaviour change campaigns such as the City’s Electricity Savings Campaign and attempting to provide a supportive policy environment for green niche technologies through policies such as a Resource Efficient Development Policy (CCT, 2016), Green Building Guidelines (CCT, 2006e) and SSEG feed-in tariffs (CCT, 2013b). A close assessment of the ECAP (CCT, 2010a) highlights that many projects are designed to incubate green niches, including the Mass Solar Water Heater Roll-out, Municipal Buildings Retrofit Programme and Atlantis Renewable Energy Hub (SALGA, 2013b). As highlighted by a ‘Report on Energy, Economics and Climate Change in Cape Town’ (CCT, 2012f), many of these nascent green technologies ‘can only be viable with government and policy support’ and these schemes thus seeks to address the ‘barriers to market penetration’ (SALGA, 2013c) that niche technologies come up against (Strategic Economic Solutions, 2012). Across interviews it was held that collaboration between innovation firms and City officials, particularly in co-developing innovations and technical solutions tailored to the city’s local challenges, are critical in facilitating socio-technical change<sup>90</sup>. Thus, in the City’s case the interaction between the state and niches is highly collaborative.

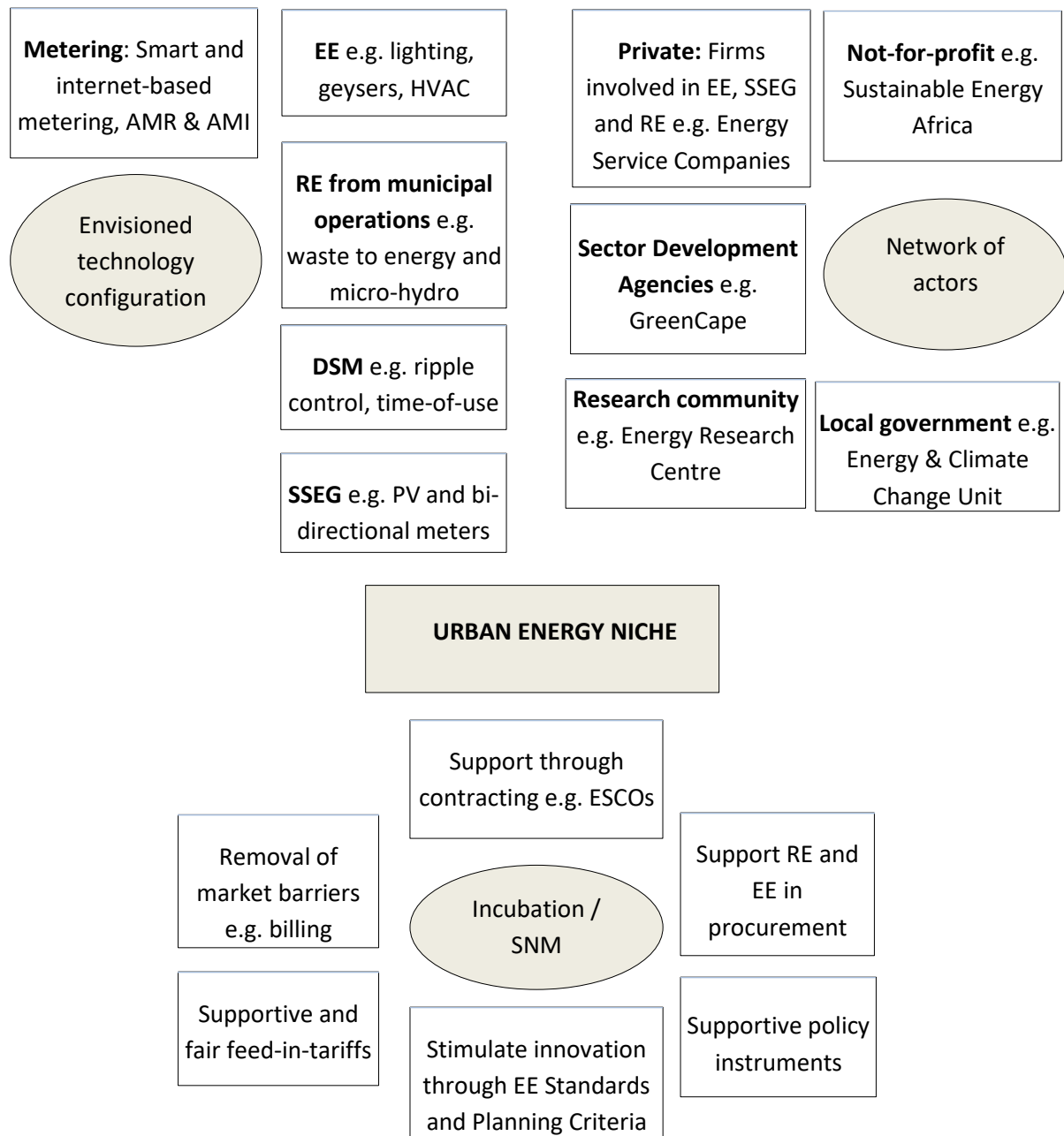
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<sup>88</sup> See Figure 10.5: Nodes in the City of Cape Town engaged in electricity reconfiguration in Appendix 5

<sup>89</sup> Strategic niche management

<sup>90</sup> See Table 10.4, in Appendix 5 on the ways in which the City incubates niches innovations

Figure 6.6: Niche in Cape Town related to sustainable energy



Importantly, this network prioritises ‘flagship’ and ‘leading by example’ projects that are intended to catalyse socio-technical change and momentum in the city’s wider community. An objective in the ECAP to ‘reduce energy consumption in Council operations’ through City-owned building, street and traffic light retrofits is positioned and marketed as a ‘lead by example’ programme in order to encourage ‘change’ in the wider Cape Town community (CCT, 2011d).

This network has coordinated a number of collaborative forums aimed at knowledge transfer amongst urban policy actors and supporting firms engaged with innovation including an Energy

Climate Change Think Tank (Cartwright et al., 2012), which acts as an epistemic community for local climate actions and the Cape Town Climate Change Coalition and associated Climate Smart Cape Town campaign (CCT, 2011b). Based on City reports and interviews these vehicles are intended to play multiple roles, including pooling of resources, knowledge exchange, coordinating advocacy, supporting niche technologies and building platforms of collaboration (CCT, 2011b; SEA, 2015b; CCT, 2015b). Importantly, an Efficiency Forum and Market-Place was established in order to 'support the commercial sector' by providing a platform for knowledge exchange and linking suppliers of energy efficient goods and services with commercial building owners and managers (CCT, 2012b). The Head of Energy and Climate holds that these partnerships facilitate 'cooperation of unprecedented levels' and are 'critical in creating institutional resilience' (Interview 23. 26 August 2012).

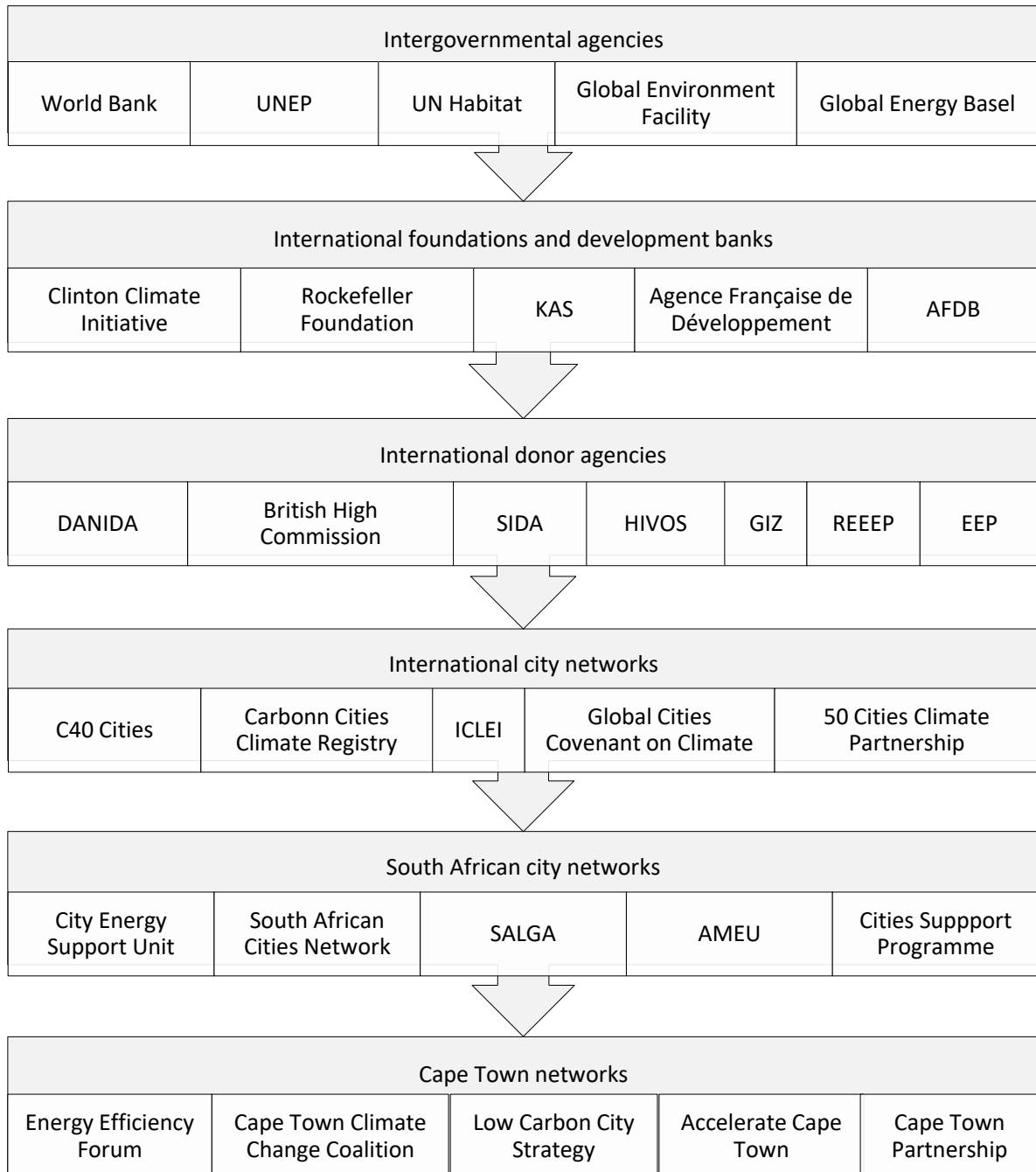
An important strategy employed by this network is to lobby national government for regulatory and policy reform in order to create top-down pressures and incentives for urban socio-technical change. City officials highlight that participation in this network enables them to operate across traditional government scales. In this regard it has established relationships with individuals across national government agencies including the Department of Energy, National Treasury, NERSA and Eskom. Through these relationships it seeks to influence national policy, using a range of mechanisms including engagement in national Portfolio Committees; commenting on draft legislation, regulation and policy; and participation in national energy forums and meetings. In this way it attempts to influence the landscape level.

Related to the above, this network makes use of umbrella organisations including SACN, City Energy Support Unit, SALGA and AMEU to consolidate and relay positions to national government, exchange knowledge, develop joint strategies and increase bargaining power against national government (SACN, 2013; SEA, 2009; SALGA, 2013a). It also engages directly with other South African cities in order to exchange knowledge and 'share lessons' (SALGA, 2013a). In cases where one city innovates or pushes the boundaries of what is legally permissible in terms of energy initiatives, other cities tend to follow suit. As a result of strong energy and climate change policy and implementation 'national government often requests the City to transfer knowledge' to smaller municipalities around successful project implementation (Programme Manager: Sustainable Energy Africa. Interview 10. 24 June 2012). The City has thus developed 'transition initiatives that are taken up by national and cascaded down to other cities' (Hodson and Marvin, 2010: 480).

Due to the multi-scale nature of energy and climate challenges, this network has persuaded City politicians to formally commit to several transnational 'advocacy' networks (Lindseth, 2004). These include the Cities Climate Change Covenant, Carbonn Climate Cities Registry, C40 Cities Network

and the Clinton Climate Initiative (CCT, 2015b). There are two main motivations communicated for persuading the City's political stratum and Mayor to join these international platforms. First, these international platforms provide opportunities for resources, knowledge exchange and learning. Second, according to the Head of Energy and Climate Change, it is intended as a means to 'apply pressure' and a system of accountability on local politicians and officials to 'act in accordance with international commitments and trends' (Interview 23. 26 August 2012).

Figure 6.7: Multi-level actors supporting Cape Town's energy transition





Recently, this network initiated 'Cape Town Energy 2040' vision process. This visioning is intended to 'develop a long term (25 year) energy plan for Cape Town' and incorporate a 'vision of a city-wide energy future into local government policies' (CCT, 2015b). According to the CEO of GreenCape, the process is aimed at 'facilitating broad stakeholder engagement that includes commerce and industry, provincial government, the City, NGOs and academia' (Interview 15. 16 September 2013). The aim of the process is to negotiate, discuss and pursue a common long-term vision for Cape Town's energy future. As the Energy Vision covers a 25-year time line it allows stakeholders to participate in an unencumbered manner and without being concerned by implications such as capacity constraints, cost burdens, technical obstacles and regulatory barriers. In this way it seeks to facilitate a process of 'thinking about the type of legacy everyone wants to achieve' (Interview 23. 26 August 2012). The process itself moreover seeks to 'build networks and persuade participants on desirability of system change' (Meeting 47. CCT Energy and Climate Change Unit. 16 January 2013). Moreover, through a process of backcasting, a clearly defined set of actionable targets may be established as well as systems for monitoring and evaluation (CCT, 2015b).

The governance modalities and policy agenda adopted by this network aligns closely with reflexive governance modalities with origins in the Global North such as strategic niche management, transition management and multi-level climate governance. It is thus necessary to evaluate the context-specific implications and factors in such governance in light of critiques by Pieterse (2008) and Lawhon and Murphy (2011).

Notably, community groups, social movements and NGOs focused on the social dimensions of energy and energy justice were notably absent from visioning processes, knowledge transfer, policy development, framing the nature and focus of socio-technical change sought and the types of technology to prioritise for incubation. Community movements such as Abahlali baseMjondolo and the Social Justice Coalition that focus on service delivery aspects of infrastructure were seldom engaged or consulted in these governance processes. According to the Policy and Research Manager of the Electricity Governance Initiative, more socially geared NGOs that consistently 'voice concerns around energy poverty and development' are largely left out of dialogue and framing socio-technical reconfigurations (Interview 7. 12 August 2013).

Further, the targets of governing socio-technical change within visioning, knowledge exchange and niche incubation by this network were predominantly framed in terms of 'environmental performance'. Plans and policy for reconfigurations are replete with terms such as smart, green, connected, modern, networked, competitive and efficient cities. Conversely, there is limited focus

on 'sustainable lives and livelihoods' (Pieterse, 2008), justice, inequality, development, poverty or other indicators and dimensions of social sustainability.

In essence it is evident that this urban network is positioning and marketing the City of CT as a 'global', 'first-class', 'resilient' and 'smart' city (CCT, 2015b) aligned to an international network of funders and partners such as C40 Cities, largely within an urban, ecological security and modernism narrative (CCT, 2015b). These include high-level programmes and partnerships such as greening the World Design Capital, a Green Goal Legacy programme for the 2010 World Cup and being crowned the WWF Global Earth Hour City Capital in 2014 (CCT, 2015b). Not only does the City of CT partner with highly developed cities such as Aachen and Munich and multi-national consultancies and technology firms such as Siemens, but the actual framing of partnership and funding agreements and the focus of knowledge exchange and collaboration is based almost exclusively on green niche and technology development.

### 6.3. Discussion:

#### 6.3.1. Conditions underpinning regime configurations and reconfigurations

This chapter provided a brief examination of the history of the configuration and subsequent reconfigurations of the City's electricity regime. Although this was by no means a comprehensive assessment of how history influenced the incumbent governance configuration, it nevertheless yields a range of insights of conceptual relevance to sustainable transition theory. First, this chapter reveals that specific regime values (and modes of thought) are integrated into socio-technical regimes at different points in time, stemming from political, economic and social drivers for change. This builds on the first chapter, which identifies the significance of regime values. However, this chapter expands the fact that the process of regime value integration within socio-technical systems is not static. Nor do regime reconfigurations result in a complete replacement of one set of regime values with another set of values. Rather, residues of previous regime values may be absorbed within a reconfigured regime. Through time, socio-technical regimes may thus be made up of multiple layers of different regime value sets that become absorbed and stabilised within their structure and function. Thus, regime reconfigurations may be (re)conceptualised as an alignment, absorption and stabilisation of diverse and sometimes competing regime values. These can be termed 'regime value realignment processes'.

Second, related to the above, this chapter demonstrated that 'regime value struggles' both precede and provide the conditions that make reconfigurations possible. This, to some degree, applies conflict theory (Genus and Coles, 2008) particularly Marxist approaches, to understanding the role of contestation in stimulating regime change. This offers a fresh perspective into understanding the

co-evolutionary process of regime formation and stability outlined by Geels (2004); by conceptualising them as dialectic cycles that span time. Thus, regimes and reconfigurations may be (re)framed as systems of values that are shaped and reshaped by perpetual regime value struggles. Further, it is evident that changes in values and belief systems, that influence regime reconfigurations, are accompanied by changes in social contracts in relation to infrastructure.

Third, the structuralism inherent in the quasi-evolutionary underpinning of the MLP negates the importance of collective action, interest groups and civil society in facilitating change (Genus and Coles, 2008; Shove and Walker, 2010; Smith and Grin, 2010). In contrast, this chapter highlights the central role of activists, NGOs, communities and academics in fracturing regimes and creating fertile ground for change. This supports a conceptualisation of reconfigurations through the lens of conflict theory (collective action and movements) and more aligned with Smith and Stirling (2008) in respect to agency and the ability of networks of actors to influence change. This challenges a completely structural understanding of regimes and reconfigurations as monolithic macro-processes with very limited scope for influence by social movements, networks and collective action (Geels, 2004).

Four, this chapter identifies a number of core factors, processes and conditions that result in reconfigurations. These are top-down<sup>91</sup> state-driven reconfigurations<sup>92</sup>; bottom-up/grass roots upsurge or internal regime crisis (or collapse). The latter reaffirms that regime crises open up spaces for potential reconfiguration processes. In the City's case, however, it is evident that these 'windows of opportunity' (Kemp and Loorbach, 2006) not only provide opportunities for niche innovations to breakthrough, but also state responses that may shape socio-technical regime reconfigurations. Thus, disruptions in the landscape level also create space for innovative policy related to socio-technical regimes, which otherwise would not be entertained, to be mainstreamed. Further it indicates that during periods of regime stability actors have limited ability to influence system change. Conversely, agency and capacity for change is heightened during periods of crisis. Notably, this chapter demonstrates that regime crises opens up space for regime reorganisation based on different regime values. In applying the language of Hegelian Marxism to socio-technical transitions, this chapter shows that landscape pressures make existing socio-technical regimes look less 'natural' and provide windows of opportunities for new regime values and hegemonies to take root alongside the 'emergence of new consciousness' (Gramsci, 1937) in relation to regimes<sup>93</sup>.

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<sup>91</sup> Alternatively, command and control regulation

<sup>92</sup> See Section 6.2.1

<sup>93</sup> Although it is recognised that crises as an opportunity for change is widely studied (Castán Broto, et al, 2014) in diverse fields, this study focused on Marxist ideas of crises due to the relationship between crises and contestation.

### 6.3.2. Regime-niche structure and the role of the state in reconfigurations

The results presented in the chapter further provide insights into the regime-niche relationship and the role of the state in reconfigurations. From the City's historical configuration and reconfiguration processes and the current (environmental) reconfiguration it is evident that the relationship between the state (the City), niche innovations (innovation firms) and other actors (civil society) is far more fluid than the 'rational choice' model offered by ecological modernism paradigms (Geels, 2004). In the City's case it is evident that niche innovations were marketed, subsidised, mainstreamed and incentivised by the City (state) and a loose network of actors in an attempt to solve complex infrastructure challenges. This support for niche innovations goes beyond strategic niche management. In the City's case an alternative socio-technical regime, based on different values (and ideologies and belief systems) was envisioned first. This network then attempted to select, nurture and mainstream a set of embryonic niche technologies in efforts to cultivate the envisioned alternative regime. This, rather than quasi-evolutionary forces, provided opportunities for firms to improve these innovations and hence compete with incumbent technologies. This underscores an iterative and mutually constituted process between the state and niche firms, which facilitates the 'break through' of innovation.

Second, related to the above, it is evident that innovation studies and transition management over-emphasise the role of private niches in transitions. In the City administration, nodes and networks, with the specific function of facilitating regime reconfigurations, were present. This may be referred to as a 'public niche'. It is evident that transitions transpire from a combination of state intervention (or state innovation) and private sector innovation. Collaboration between public niches and private niches thus disrupt regimes. Sustainable transition research, including innovation and niche management studies deems niche (innovation) firms as the sole generator of innovation. This chapter highlights a broader range of sites in which innovation may transpire including nodes in the state and not-for-profit organisations. It further supports a broader conceptualisation of innovation that embraces a diversity of forms rather than single-mindedness towards technical innovation to the exclusion of policy, regulatory and institutional innovation.

Finally, the above offers further insights into debates on the role of the state in transitions. Rotmans *et al.* (2001) asserts that the state can play a range of different roles in steering transitions including initiating or directing transitions. As mentioned, in our case, nodes in the City of CT (State) played an important role in building a shared strategy for change across society; moulding an agenda for change; upscaling, mainstreaming, incubating and providing supportive policy environments for niche innovations; creating learning opportunities; making landscape pressures visible; nurturing

awareness<sup>94</sup>; lobbying core regime members; and supporting transition trends already under way. These nodes in the City (alongside a network) further played an important role as ‘system builders’ through attempting to establish a ‘seamless web’ (Bijker, 1995) by aligning regulatory, technical, social and economic elements of an envisioned socio-technical regime. Notably, means employed included regulating innovation; investing in nascent innovation; and shaping the preferences of end-users and citizens through subsidises, incentives and support instruments. Thus, this chapter highlighted that the state may play a significant role in shaping the relationship between society and technology.

### 6.3.3. Transition intersections and socio-technical outcomes of trajectories

Sustainable transition theory seldom explores the socio-economic outcomes or the political economy of transitions (Meadowcroft, 2009). Further, policy and governance related to sustainable infrastructure change typically ignores the ways in which technologies are embedded in society and associated socio-economic implications (Genus and Coles, 2008) and the political effects inherent in particular technological configurations (Boulanger, 2010; Meadowcroft, 2009). This forms part of a wider critique related to the technological determinism inherent in the policy, practice and theory of sustainable socio-technical change.

This chapter applied a constructivist approach to understanding socio-technical regime change by describing multiple potential pathways in the City of CT that could create radically different socio-technical configurations and socio-economic outcomes. This highlights that, depending on policy choices, the state may steer reconfigurations with radically different socio-economic outcomes or expressions. These are points in time at which multiple potential transition trajectories are possible. These may be referred to as ‘transition intersections’ or ‘transition cross-roads’.

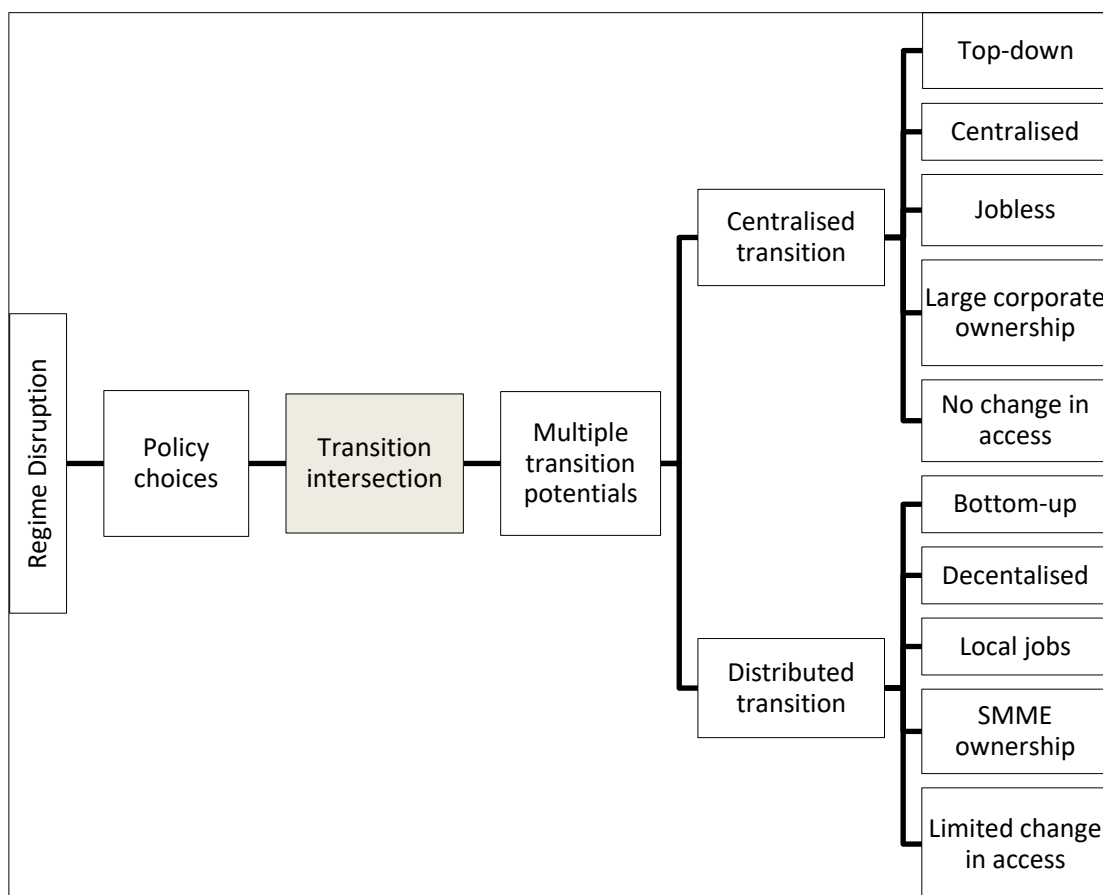
This chapter explored two potential trajectories in the City; a large centralised supply-driven option or a decentralised demand-side-driven option. The former (large centralised) trajectory would result in limited change or impact in relation to ownership and control, jobs, access and other socio-economic indicators. On the other hand widespread uptake of distributed energy (SSEG) in Cape Town would radically reconfigure the City’s electricity system and change ownership patterns to some degree. However, as highlighted in the preceding chapter, it would negatively impact on redistribution and energy poverty alleviation if pursued without appropriate mechanisms and safeguards to ensure continued financing of cross-subsidy systems and energy service provision for the poor.

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<sup>94</sup> or articulating selection pressures

These scenarios provide the basis for a model to explore and evaluate the socio-economic expressions or outcomes of transitions. Such a heuristic may incorporate a range of indicators of socio-economic outcomes of different reconfiguration pathways. These may include, *inter alia*, the principles underlying policy and decision-making (Lawhon and Murphy, 2011); resource control and ownership; underlying modes of thought; realignment of power; institutions that benefit from a specific trajectory; and behavioural and cultural shifts in relationship to technology (Genus and Coles, 2008). An illustration of such a model, using the two trajectories described in the City, is provided in Figure 6.8.

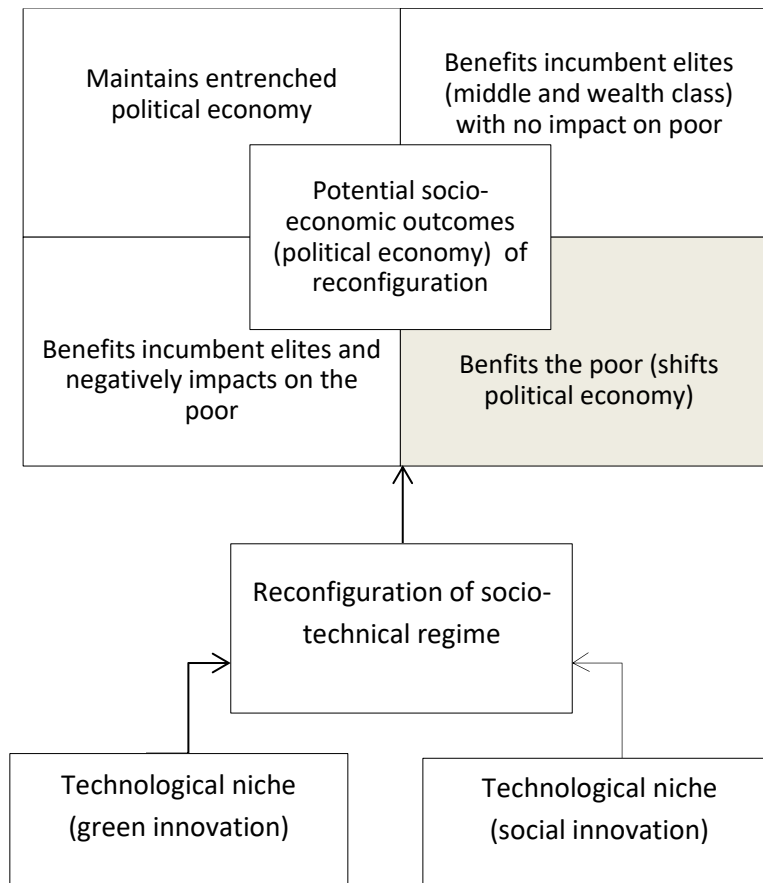
Figure: 6.8: Socio-economic expressions of transitions



In addition, the City of CT's case provides the basis for a heuristic to assess the outcomes of reconfigurations according to the reproduction or change of the incumbent political economy. This classification can include whether a reconfiguration; a) maintains the entrenched political economy; b) benefits the wealthy and middle-class without impacting the poor; c) benefits the wealthy and middle-class and simultaneously negatively impacts on the poor; or d) benefits the poor. The latter scenario results in a shift in the political economy. This heuristic is illustrated in Figure 6.9. This offers a tool to explore and evaluate the 'winners and losers' of sustainable reconfigurations, the political economies (Walker, 2006) entrenched in socio-technical regimes and

the extent to which the incumbent political economies are reproduced or shifted during reconfiguration processes.

*Figure 6.9: Political economy of transitions and transition outcomes*



The above approach fuses a social construction of technology (SCOT) approach with notions of regime change whereby the open-ended character of technology development (Meadowcroft, 2009) may be explored and issues such as social impact, access and equity of particular trajectories are dissected in socio-technical reconfiguration analysis. Such an approach is more sensitive to locally specific agendas and solutions (Pieterse, 2008) and provides a means to consider diversity in development pathways rather than a prescriptive model of global homogeneity (Huchzermeyer, 2011). In particular, it provides greater scope for exploring the relationship between society and technology (Bijker, 1995) and investigating the kinds of social systems that particular technological configurations foster and co-create. There is value to applying such an approach to cases that examine infrastructure socio-technical regimes in Global South contexts; where multiple potential development pathways are conceivable. This is in contrast to the prescriptive ecological modernist leanings of sustainability policy and practice.

## Theoretical reconfiguration processes and dynamics

This chapter further explored the presence of positive feedbacks, tipping points and cascades in socio-technical transition processes. This applied concepts stemming from dynamic systems theory to examining reconfiguration processes. The City's case provides the grounding for three different theoretical pathways that describe causality of change in socio-technical regimes. These have similarities to transition contexts described by Geels and Schot (2007) and Berkhout et al. (2004). However, they offer a slightly different insight into reconfiguration processes.

The first typology may be termed a 'positive feedback pathway'<sup>95</sup>. This describes change that is circular and self-reinforcing. In terms of the results, such a transformation appears to potentially occur where regime members respond to selection pressures (or disturbances) using internal resources and the same means at their disposal for dealing with past (linear) challenges and the response itself creates a self-reinforcing loop that further exacerbates the challenge and further transforms the socio-technical system. This positive feedback pathway borrows concepts developed in resilience theory and broader dynamic systems theory (Folke et al., 2004) and challenges the somewhat implicit assumptions of system equilibrium in sustainable transition studies. Although a positive feedback transformation may be caused by a particular response to a selection pressure, it is also emergent in nature, stemming from structural contradictions within a system.

The second typology may be termed a 'cascading pathway'<sup>96</sup>. Such a pathway may potentially occur where regime members react to a selection pressure using internal resources, through integrating a niche development into the system to deal with an isolated challenge. The response accordingly utilises the same underlying motivation, to protect the integrity of the system, through a slight alteration. However, the response to the selection pressure causes a cascade of events that further exacerbates the challenge and eventually results in a transformed system. This is similar to a positive feedback pathway, although the pattern of change resembles a domino effect rather than a self-reinforcing loop. A cascading pathway has similar features to a reconfiguration process described by Geels and Schot (2007) in that both occur when niche innovations are adopted by a regime to solve local problems. However, within a cascading pathway the adoption of such a niche innovation exacerbates the underlying problem it was intended to solve in the first place. It thus assimilates notions, developed in resilience theory related to the self-fulfilling prophecy of

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<sup>95</sup> See Section 6.5.1

<sup>96</sup> See Section 6.5.2



command and control management in response to complex 'non-linear' challenges (Elmqvist et al., 2003).

The third typology may be termed a 'tipping-point pathway'. This borrows concepts developed in dynamic systems, earth systems science and resilience, such as ecological boundaries and tipping points (Capra, 1982; Holland, 2005), to illustrate that socio-technical regimes also have saturation points where multiple pressures may force a change into a different domain or basin of attraction.

The above pathways contribute to typologies developed by Geels (2007) and Berkhout et al. (2004) that classify and examine the conditions under which regimes change. However, the above pathways elaborate on transition typologies by focusing on the conditions under which regimes may rapidly unravel and the associated social, political and economic ramifications of these disequilibrium states. Accordingly, they, to some extent, reconcile classifications of regime change with concepts stemming from both conflict theory and dynamic systems theory and align somewhat with Marxist sentiments. In brief, they describe reconfigurations that result from contradictions or system flaws that are inherent in a socio-technical regime (Jarvikoski, 1996; Foster, 1999; Gramsci, 1932) that may lead to their inevitable undoing or rupture. These are particularly relevant to socio-technical regimes in the Global South where the social elements of infrastructure regimes are under considerable pressure.

#### 6.3.4. Typologies of transformation in cities in the Global South

It is evident that the existing classifications or typologies of regime transformation (Geels and Schot, 2008) do not adequately consider the socio-economic outcomes of transformation processes, value tensions inherent in regimes (and reconfigurations) and contestation within socio-technical regimes and reconfigurations. In Global South contexts, this is manifested by a blind spot in describing the social dimensions and socio-economic impacts of sustainable transitions (Meadowcroft, 2009). In response, the findings of this chapter provide the building blocks of theoretical typologies of transformation that are more sensitive to Global South contexts. These provide insight into theoretical implications of regime value tensions between developmental and environmental values outlined in the preceding chapter.

A regime reconfiguration may theoretically occur whereby only the environmental criteria of sustainability are pursued and achieved, at the expense or neglect of social and development values. This may be referred to as a 'green gated regime reconfiguration' in connoting 'gated communities' prevalent in South African cities (Parnell and Pieterse, 2014). A green gated regime transformation is an exaggeration of the existing splintered urbanism (Graham and Marvin, 2001; Jaglin, 2008) and differentiated infrastructure provision (Savage and Ward, 2003) present in the

Global South and applies these insights to sustainable transitions based solely on environmental performance. In brief, a green gated regime configuration would be characterised by well-serviced, modern and increasingly 'green' infrastructure provision to middle and high income citizens on the one hand, and sprawling informal settlements without access to infrastructure services on the other. It is evident that policy towards 'premium green' cities (Myers, 2008) comes at the expense or neglect of development. This typology of transformation has theoretical utility, particularly when exploring infrastructure socio-technical regimes in Global South contexts; in conditions with intense inequality and poverty in relation to infrastructure, but where 'elite groups' are pushing 'green city' or 'smart city' ecological modernist agendas (Huchzermeyer, 2011).

A 'social grey regime transformation' would achieve the opposite effect, sitting on the opposite end of a spectrum. Such a transformation accomplishes indicators of social sustainability such as reduced inequality of infrastructure provision, consolidation of resource distribution<sup>97</sup>, poverty alleviation and universal provision of infrastructure services. Such a transformation may occur where development values are fully integrated into a regime. Thus, a sustainable transition would occur based on social sustainability criteria alone. However, it would ignore environmental indicators and the regime would remain highly unsustainable in environmental terms. In fact, such a transformation would negatively impact on environmental sustainability, through increasing access to electricity and hence increased consumption, without a corresponding adoption of low carbon or efficient technologies.

An 'integrated sustainability transformation' is a normatively ideal regime reconfiguration in which stakeholders manage to navigate the systemic value tensions between the various pillars of sustainability<sup>98</sup>. In this and the preceding chapter it was demonstrated that incremental change or reconfigurations based on environmental values may have significant negative impacts on development values. Due to the complexity of socio-technical regimes a range of potential unintended socio-economic impacts ensue when environmental reconfiguration initiatives trigger tipping points or cascades that augment 'splintered urbanism' (Jaglin, 2008) or differentiated infrastructure provision. Thus, an integrated sustainability transformation could not be emergent. Rather, a degree of purpose and coordination would be required to prevent emergent/unintended consequences. This would require analysis of the impacts of different transition interventions on different regime values and the linkages between sub-elements of a regime, through the lens of values. Further, incumbent regimes contain a mix of elements perceived as 'harmful or beneficial' (Agyeman et al., 2003) that are intimately coupled within regime structures. An integrated

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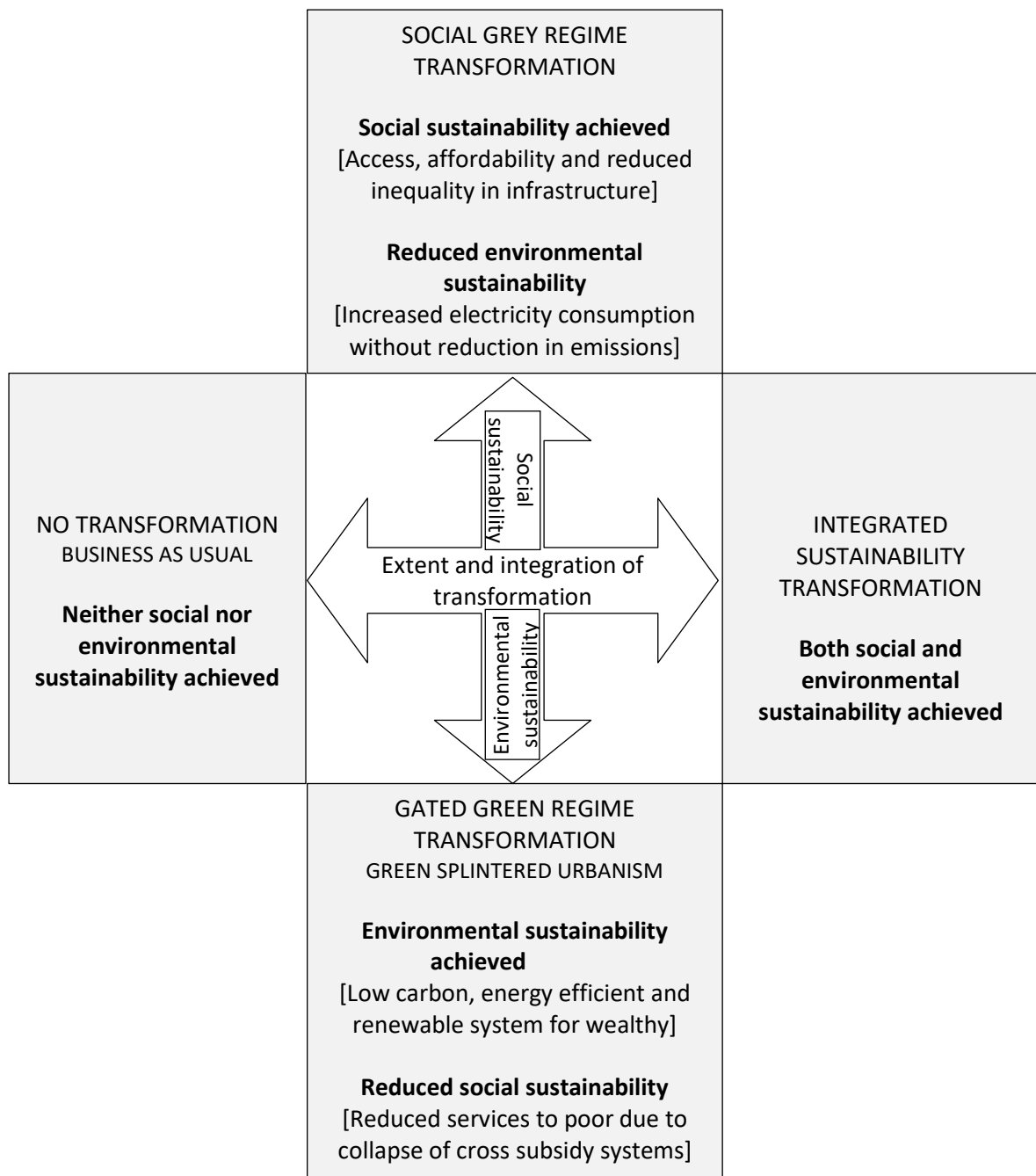
<sup>97</sup> Through cross-subsidisation and affordability

<sup>98</sup> Economic, environmental and social

sustainability transformation would thus actively intend to maintain and incorporate beneficial (functional) elements into the new alternative regime structure.

Finally, a scenario where ‘no transformation’ is undertaken is also plausible. In this case the socio-technical regime remains neither socially or environmentally sustainable. These transformation typologies (or scenarios) may be represented in a quadrant (Figure 6.10) with the extent and integration of a transformation on one axis and social and environmental sustainability on another axis. The empirical basis for these typologies, which provide a glimpse of what they might look like in Cape Town, are explained in Section 6.2.4.

Figure 6.10: Theoretical typologies of transformation in the Global South



### 6.3.5. Governing socio-technical transitions in the Global South

This chapter explored the relationship between regimes, urban networks and traditional government hierarchies (Bulkeley and Kern, 2012). Hodson and Marvin (2010: 480) submit that the focus on the national level implicit in the MLP begs the question of ‘where do cities sit within the landscape-regime-niche hierarchy’. Moreover, the MLP is silent on the modes and means in which urban actors govern socio-technical change and how these processes interact with and influence regime stability or change. The findings of this chapter highlight the presence of multi-level governance modalities occurring alongside the landscape-regime-niche hierarchy. In the City, it is evident that urban networks, comprised of actors both within and outside local government, operate within and alongside regime structures in fluid networks in order to sidestep institutional conditions that obstruct transitions. Based on these findings, it is possible to conceptually bridge urban climate governance modalities identified in literature with its impact on regime reconfiguration and identify its relationship with the niche-regime-landscape hierarchy. This to some degree applies concepts developed in multi-level climate change governance literature (Smith and Stirling, 2010) to examining change in socio-technical regimes.

*Table 6.2: Urban governance modalities and interactions with MLP hierarchies*

Mode of urban governance	Interaction with regime and niche
Enabling	Support niche innovations
Self-governing / leading by example	Support niche and articulating selection pressure to broader community
Provision of service	Adjustment to regime
Regulation	Regulating regime change
Niche incubation	Incubating niche to facilitate competition with regime
Transnational networks	Facilitating and enhancing landscape pressures and articulation of selection pressures by regime members
Nodes of support	Coordination of resources to steer change; changing regime from within
Partnerships	Coordination of resources to steer change and incubating niches

Second, this chapter explored the disjunctures between Global North governance modalities and Global South realities. Notably, it highlights that the governance features that are absent in the approach adopted by the urban climate network are precisely the features of governance derived from literature that is more grounded in Global South contexts. In the City, change management has in essence been led by a ‘transition arena’ comprised of technocrats and experts, with very little focus on grassroots or ‘effective politics’. This transition arena adopted a vision for socio-technical

reconfiguration rather than a grounded alternative vision that is based on the realities of infrastructure poverty, access and development priorities. This vision moreover was framed and conceptualised narrowly on the grounds of environmental performance rather than a focus on 'sustainable lives and livelihoods' (Pieterse, 2011). This highlights that governance modalities originating in Global North contexts are often ill-suited to governing socio-technical change in the Global South, even though they tend to be adopted by Global South change agents.

The above reinforces critiques against transition management on elitism and under-representation of marginalised interest groups (Genus and Coles, 2008; Shove and Walker, 2007a). In the City's case the governance of reconfigurations did not engage marginalised groups in processes of knowledge exchange and visioning. The impact of such exclusion is important. In this context, under-representation resulted in green technocrats and policy elites framing and governing apolitical regime reconfigurations based on technocratic (technology bias) and ecological modernism underpinnings. This is particularly important in relation to the argument raised in the preceding chapter that regimes are constituted from contested values and agendas, which in turn require representation by a range of social interests. This highlights the importance of evaluating the ways in which different social interests are considered (Hodson and Marvin, 2010) and prioritised in the governance of reconfigurations.

Related to the above, it is evident that governance of socio-technical transitions in the Global South create tensions between environmental and development values and concomitant reconfiguration policy agendas. Thus, the argument developed in the preceding chapter, that regimes are underpinned by competing values, is equally relevant to the process of managing change in socio-technical regimes.

Notably, the findings of this chapter demonstrate that transition management in urban contexts in the Global South tend to create and reproduce a 'world' or 'premium city' narrative around modernisation, efficiency and competitiveness (Murphy, 2015); whereby cities in the south market themselves as global green investment destinations. This to some degree may be to the detriment of other contested agendas, including developmental agendas (Hurzchemeyer, 2011). Finally, as argued in the preceding chapter, network infrastructure is subject to greater monopolisation, with less competitive markets, in the Global South. Thus, the risks of corporate hijacking of visioning processes appear to be pronounced in relation to socio-technical transitions in the Global South. At the very least, it is evident that green policy elites (or transition arenas) collaborate with and are more closely aligned to innovation-technology firms than community groups in framing vision and transition agendas.

## 6.4. Conclusion

This chapter aimed to contribute to three areas related to sustainable transitions of socio-technical regimes, namely: the conditions under which systems change; potential pathways and typologies of change; and the governance of change. First, this chapter outlined historical reconfiguration processes in the City of CT in order to explore the conditions that make change possible. This provided a number of insights. It highlighted that regime value struggles both precede and provide the conditions that make reconfigurations possible. Accordingly, regime reconfigurations may be understood as an alignment and stabilisation of diverse and sometimes competing regime values. Notably, it demonstrated that regime crises open up space for regime reorganisation based on different regime values. It further highlighted the central role of activists, NGOs, communities and academics in fracturing regimes and thus explored reconfigurations through the lens of conflict theory.

Second, this chapter demonstrated that the relationship between the state (the City), niche innovations (innovation firms) and other actors (civil society) is more fluid than the 'rational choice' model prevalent in several sustainable transition frameworks including innovation studies and the MLP (Geels, 2004). Further, it conceptually identified the presence of public niches - or sections of the state with the specific function of facilitating change - and argued that collaboration between public niches and private niches disrupt regimes.

Third, the chapter identified two broad energy trajectories that the City of CT is able to pursue. This informed a model to explore the socio-economic expressions and impacts of different socio-technical trajectories and potentials at transition intersections. Such an approach is attuned to understanding the social construction of technology; is cognisant of multiple potential socio-technical trajectories or development paths in the Global South; and considers the political effects of technology choices. This further enabled an examination of the political economy of socio-technical transitions.

Four, in explorations of pathways and typologies of change, this chapter offered hypothetical reconfiguration processes as conceptual tools for classifying transformations in Global South contexts, under conditions of extreme inequality, poverty and marginalisation. These included a tipping point, cascading and positive feedback transformation that employs concepts from dynamic system theory and conflict theory to understand reconfigurations in Global South contexts. Furthermore, transition scenarios, that are cognisant of the socio-economic outcomes of reconfigurations, were identified. These included a green-gated, social-grey and integrated

sustainability transformation. The empirical grounding of these scenarios is provided in section 6.3.5.

Five, this chapter applied a multi-level climate governance lens in examining the governance of transitions and stemming from this, sought to identify and discuss the interactions between the niche-regime-landscape hierarchy, traditional spheres of government and multi-level governance. Finally, this chapter identified the presence of 'reflexive governance' modalities (transition management and visioning) in the City and reflected on the tensions between Global North governance modalities in Global South realities. The central themes brought to the fore in this regard include competing values; representation and exclusion; and the contested visions of urban transitions.

## Chapter 7: Regimes and regulation

### 7.1. Introduction

The overall aim of this chapter is to examine the relationship between rules (regulation) and regimes. This enquiry has a number of connected foci. First, it explores the role of rules in shaping regime stability, reproduction (Geels, 2004) and potentials for change. This is empirically tested through evaluating the ways and extent to which top-down regulatory frameworks have shaped the City's electricity regime around dominant structures and functions. In particular, this examines the relationship between rules and the concept of regime values, as argued for in preceding chapters.

Second, this chapter seeks to build on arguments in previous chapters related to the tensions between national and urban transitions through exploring the manifestation and stabilisation of these disjunctures in rules. This enquiry is tested by examining the alignment and coherence (Geels, 2002) in regulation between national government and the City of CT in relation to transition ambitions. This informs discussion on decentralisation of regulatory autonomy related to urban transitions (Späth and Rohrer, 2012; O'Brien and Hope, 2010) particularly in contexts where urban networks are highly entangled with nationally bounded regimes<sup>99</sup>.

Third, this enquiry engages with the interactions (interference) between rules and other regime elements (Genus and Coles, 2008) as well as the temporal dimensions of the co-evolution between rules and other regime elements (subsystems). This is done through analysing the ways in which top-down rules interfere with the functioning of various subsystems of the City's electricity regime and the misalignment between rules, technology and implementation. In particular, this focuses on the extent to which top-down rules are synchronised or aligned with the evolution of technology.

Four, as mentioned, MLP research seldom investigates rules in organisational settings. Accordingly, processes of interpretation and negotiation around rules within organisations have not been sufficiently theorised. In response, this chapter identifies and examines the ways in which officials<sup>100</sup> engage with, interpret, contest and negotiate top-down rules. In particular, it explores the underpinning rationale, related to regime values, cultures and visions, behind compliance or non-compliance with rules. This seeks to provide insight into debates related to agency (Smith and Stirling, 2010) and the ways in which regime rules are shaped, reproduced and adapted through

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<sup>99</sup> Lower agglomerations

<sup>100</sup> Implementing agents



processes of negotiation between social groups (Rip, 1995). This is particularly relevant to debate on the extent to which regime rules are fixed. Geels (2004) argues that regimes rules are largely impenetrable to change whereas Kemp and Loorbach (2006) argue that rules are constantly adapted in practice.

Finally, this chapter juxtaposes top-down regulatory frameworks with bottom-up responses in order to explore themes related to, *inter alia*, command and control versus adaptive management. This is done through identifying and classifying the different approaches that are employed by City officials in response to top-down rules and the concomitant threats to the structure and function of urban regimes.

## 7.2. Results

### 7.2.1. Top-down regulatory frameworks and values

This section explores the ways in which rules have structured the City's electricity regime and the regime values that such regulations enforce. It further touches on the relationship between mandates and regime stability or change.

It is evident that the structure and function of the City's electricity regime is primarily shaped by regulation. Electricity functions are provided for in the Constitution, 1996, Municipal Structures Act, 1998, the Electricity Regulation Act, 2006 and a suite of standards including the Distribution Network Code (NERSA, 2007a). The Electricity Regulation Act, 2006 particularly fleshes out these functions and it is accordingly important to examine the way it is framed. The Act prescribes that municipalities have to, *inter alia*, 'comply with all technical requirements' determined by NERSA<sup>101</sup>, 'progressively ensure access to basic reticulation services' at minimum costs to low-end users<sup>102</sup>, adhere to national standards<sup>103</sup>, report regularly to national government<sup>104</sup> and execute its functions 'in accordance with national energy policies'<sup>105</sup>. It is evident that these delegated functions are highly prescriptive and reinforce national government control and local government subservience.

However, the above also underscores that top-down rules frame and reinforce the values that underpin socio-technical regimes. As discussed in the preceding chapter, the end of apartheid brought about sweeping changes in the energy landscape. During this democratic transformation the regulatory system was a decisive tool for reconfiguring the national electricity regime based on

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<sup>101</sup> s.27(a)

<sup>102</sup> s.27(d)

<sup>103</sup> s.27(f)

<sup>104</sup> s.27(g)

<sup>105</sup> s.27(h)

radically different modes of thought and principles, including redistribution and universal access to electricity. These legal frameworks, developed by national government, assigned considerable duties for implementation to local government.

In terms of the INEP (DOE, 2005) the City of CT has substantial duties to facilitate universal electrification (Bekker et al., 2008). Financing for electrification is predominantly raised through cross-subsidies from municipal bulk sales. At the same time national government introduced the Free Basic Electricity Policy (DME, 2003b) which states that FBE must be financed through cross-subsidies and administered by local government. The City is further charged with implementation of the Electricity Pricing Policy (DME, 2004), which establishes an Inclining Block Tariff to enable cross-subsidisation and ensure affordable electricity for poor households. The City is also legally required to administer several other programmes introduced to address energy poverty including the roll-out of energy services such as solar water heaters (DME, 2005), ceilings (DME, 2007) and insulation for low-income households (DOE, 2013).

In essence, it is apparent that national government utilised the regulatory systems to ensure municipalities implement policy to redress historical inequalities through pursuing universal access to affordable energy for the poor (Prasad, 2008). The developmental regime values that these rules enforce have thus become entrenched in the City's electricity regime. Thus, rules formulated by national government cemented the development values that underpin the City's incumbent electricity regime.

In contrast, a suite of rules has been introduced that intend to regulate municipal engagement in efficiency and renewable energy (environmental sustainability). These rules are less coherent and often disregard the role of cities in these transition processes. Notably, national energy policy such as the Integrated Resource Plan for Electricity, 2010-2030 (DOE, 2011e), National Energy Efficiency Strategy (DOE, 2013), the REIPP Programme (DOE, 2012) and National Carbon Tax Policy Paper (NT, 2013a) are largely silent on the role of cities. The National Energy Efficiency Strategy (DOE, 2013) for instance does not assign any duty on municipalities to achieve efficiency targets despite 50% of electricity demand falling within cities (SEA, 2015b). This highlights a deliberate oversight within national energy policy on the role of cities in energy transitions. It is evident that this intentional absence of coherent rules creates inertia in implementation settings. According to the Principal Engineer: Energy and Climate:

Because of the absence of a framework or vision for local government, we are faced with fragmentary legal instruments that are incoherent and unrealistic – which will have serious problems if we implement (Interview 20. 23 August 2013).

Moreover, it is apparent that this omission serves to reproduce the incumbent national electricity regime and extend these regime logics to local electricity regimes. This is evident in national electricity planning. For instance, in the IRP modelling process DOE projected a 4% annual increase on municipal electricity demand (DOE, 2011e). However, since 2007 electricity consumption has been declining in cities (SEA, 2013a). The intentional lack of consideration of cities led to over-projected demand, which partially contributed to the justification for a large expansion programme and reproduction of centralised supply (SEA, 2015b). Nevertheless, it is evident that the absence of rule alignment amongst spheres of government partially stems from different priorities and values between local and national government<sup>106</sup>.

Notably, mandates entrenched in top-down regulation play an important role in framing the potential of transitions and constituting 'capacity to act' (Smith and Stirling, 2008). The Constitution, 1996 and Municipal Systems Act, 2000 fundamentally changed the role of local government. Only since then has local government acquired duties related to socio-economic well-being, economic development and sustainability. Prior to this the City of CT was concerned predominantly with conventional service delivery (Cartwright et al., 2012). This broadening of mandate has provided a rudimentary legal framework to initiate a transition process in the City of CT (Collier and Glazewski, 2012). Despite this framework, De Visser (2012) highlights a continued unwillingness amongst officials to realise transition objectives. Collier and Glazewski (2012: 173) similarly outline legal instruments available to the City to respond to energy and climate challenges but note that 'while there is national legislation which could accommodate the exigencies of climate change, it is seemingly disregarded at local level'.

The above reveals that mandates related to transitions tend to be contested with regards to the priorities of different spheres of government. The example of tariff-setting in the City provides a case in point. In short, regulation governing tariff-setting is unclear as to whether municipalities or the NERSA has this mandate (Glazewski, 2013; AMEU, 2010). In terms of the National Energy Regulator Act, 2004 NERSA has the sole authority to regulate tariffs and local governments may only set tariffs that are determined or approved by NERSA. Conversely, the Constitution and Municipal Systems Act, 2000 provide municipalities with this same authority. According to the Head of Pricing and Regulation, the City 'needs the mandate to set tariffs in line with socio-economic and financial imperatives' (Interview 16. 16 September 2013).

Notably, the City of CT actively resists national rules that may have revenue impacts which threaten the financial sustainability of local government (AMEU, 2012). There are a number of ways in which

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<sup>106</sup> See Section 5.2.6

the City has defended its tariff-setting powers including seeking legal opinions (CCT, 2011o), requesting clarity from national government (AMEU, 2011; CCT, 2010d), entrenching its mandate in policy and establishing tariffs<sup>107</sup> that ‘align with local socio-economic objectives’ even though they are non-compliant with national guidelines (CCT, 2012b). This highlights the structural and priority conflicts between urban autonomy and national development imperatives. This interaction and contestation is explored further in the following section.

### 7.2.2. National regulation and the City of Cape Town’s transition

Rules have multiple implications for urban transition ambitions and for the relationship between national and urban transitions. First, national rules may facilitate or support urban transitions in several ways. For instance, a number of rules provide mandatory obligations on the City to take transition steps to some extent, such as the legal directive for municipalities to implement SSEG (NERSA, 2011a) or smart meters (DME, 2008b) or provide funding for City transition interventions, such as allocations for EEDSM in terms of the Division of Revenue Act, 2012. Further, it is evident that the City of CT opportunistically advances its own transition ambitions in relation to national transition processes. For instance, the City’s IDP states:

The Department of Energy will soon appoint preferred bidders to supply renewable energy. Thus, the downstream capabilities and industry services will need to be in place. A green technology cluster park can benefit from synergies through co-location, and can serve the industry more effectively (CCT, 2012a: 46).

The above highlights that in response to national REIPP Programme, the City has aimed to market Cape Town as a manufacturing hub and established a Green Technology Park to gain jobs and economic opportunities from the national programme (CCT, 2012a).

On the other hand, top-down rules by national government may constrain urban transitions. Top-down regulations restrict a range of transition actions proposed by the City including its ability to stimulate energy efficiency and renewable energy (CCT, 2010f; SALGA, 2013c). For instance, in terms of the Electricity Regulations on New Generation Capacity (DOE, 2011d), Eskom is designated as the ‘single and exclusive buyer and seller of electricity’. This places limitations on the City’s ability to facilitate large-scale renewable electricity<sup>108</sup> (CCT, 2010f). Thus, these rules consolidate the authority and power of the national electricity regime and stabilise its structure and function.

However, there is continuous contestation and negotiation between urban autonomy and national control in regime rules. In relation to the above restrictions, for example, in 2011 the City initiated

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<sup>107</sup> e.g. feed-in tariffs

<sup>108</sup> Through either entering into a power purchase agreement or generating renewable energy from its own operations

communications with NERSA, Eskom and DOE requesting a determination on whether it would allow the City to enter into power purchase agreements for renewable electricity (CCT, 2010d; CCT, 2011h) despite the Single Buyer Office. National government responded that it would reluctantly support such applications (NERSA, 2011c). Other municipalities across South Africa have initiated similar processes including eThekweni and Nelson Mandela Bay (SACN, 2013). There is thus evidence of a shift in national policy to permit cities to supply their own renewable electricity. It is arguable that the national supply crisis and Eskom's inability to fund the new build programme is a strong motivation for relaxing rules of centralised supply. In this regard the CEO of Eskom is quoted in the Sunday Times:

The energy gap for 2012 is quite frightening. We need to look at what's possible in municipalities in terms of embedded generation and independent power producers. These need to be implemented as soon as possible (Vecchiatto, 2012).

Thus, urban climate actors in the City have used this crisis as a way to expand mandates and align their urban priorities, namely energy autonomy and decarbonisation, with the priorities of Eskom namely, ensuring continued supply (CCT, 2012h; CCT, 2011h). In this regard the Principal Engineer: Energy and Climate said:

Cities roles may not be mandated, we may not know our role; so we have to create a role. National policy and regulation always fails to consider the role of cities. We have to shape our own energy future (Interview 20. 23 August 2013).

This example above highlights the shifting nature of national regime rules particularly when regimes confront pressures such as a supply and financial crisis. However, it also suggests that rule change is dependent on relationships and communication between actors across scales. Thus, it is apparent that actors can increase their capacity to act through engagement in high-level policy and political processes. In other words, mandates and capacity to act are shaped and produced through actively pursuing greater agency.

Nevertheless, in the City there is considerable uncertainty and conflict around the regulatory capacity of municipalities to enact their own transitions rules<sup>109</sup>. Such contestation was brought to the fore when the City took steps towards adopting a Solar Water Heater By-law which would require solar water heaters in all new developments (CCT, 2007). At the start of the project the Energy and Climate Change Unit sought legal advice on whether the proposed by-law would fall within the City's mandate. The opinion stated that it is within the City's mandate based on a number of legal principles (De Visser, 2007). Importantly, the opinion stated that the Constitution provides local government with 'authority to regulate municipal affairs' and instructs municipalities to

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<sup>109</sup> i.e. the regulatory mandate to regulate

deliver electricity in a 'sustainable manner' and national government may not hinder the exercise of municipal powers. Despite this legal mandate the City failed to adopt a SWH By-law. An independent study commissioned by ERMD to understand the reasons for this failure finds that organisational factors rather than regulatory competency were to blame (Froestad et al., 2012). In brief, during the process organisational pressures arose, stemming from difference in institutional cultures between ERMD and PBDM, the two departments directly involved.

The above highlights that regime rules may constrain or enable transition action through explicitly delegating or neglecting legal mandates. However, it also demonstrates that the 'enactment' (Geels, 2001) of transition mandates is largely dependent on organisational conditions and institutional willingness.

### 7.2.3. Rule interference with the City of Cape Town's electricity regime

There are a multitude of cases of top-down rules developed by national government that interfere with subsystems of the City's electricity regime. Such interference differs in extent and form. First, several examples of top-down rules that unintentionally interfere with a coupled subsystem of the City's electricity regime are discernible. As highlighted in previous chapters, net-metering, as mandated by the Standard Conditions (NERSA, 2011a), would interfere with the City's revenue and cross-subsidy systems. However, it would also negatively impact on administrative systems. Comments by the Electricity Department on the draft regulations highlight that net-metering 'could not be elegantly applied to existing administrative systems such as billing' and would cause a range of accounting problems including 'challenges related to administering VAT' (CCT, 2012c: 2). This is reiterated by the Head of Green Energy:

There would be major problems with the matter of dealing with any excess generation from year-to-year, challenges of arbitrage across tariff increases, and applying the solution to a residential application which uses prepayment meters (Interview 11. 04 December 2012).

According to the Electricity Department implementation of the Standard Conditions (NERSA, 2011a) would create a significant risk of over-penetration of SSEG on local grid stability. It would thus require additional expenditure on reinforcing the grid to enable it to handle altered power-flow and significant 'revamping' of communication networks and 'back-end functionality' (CCT, 2013c; CCT, 2012c; CCT, 2012d; CCT, 2013b). The Head of Protection and Measurement outlines these challenges:

There is a great deal of structures that need to be in place as a prerequisite for embedded generation. These include an appropriate communications network; back-end functionality with regards to billing, pre-payment capabilities, links to telemetering,

systems for credit and offsets and systems to administer VAT. Implementation of SSEG further requires human capacity to put these systems and software in place (Interview 21. 16 September 2013).

The above highlights that new technologies require a multitude of structures and associated rules to support their integration with existing systems. The absence of provision for such structures in regulation highlights a disjuncture between rules that seek to regulate change in relation to complex coupled socio-technical regimes.

Second, it is evident that there is frequently misalignment between rules that instruct an intervention and the existing structures of socio-technical regimes. For instance, the Compulsory Norms and Standards (DME, 2008b) directed municipalities to ensure that all large electricity users are on a time-of-use tariff. The Electricity Department argued that the City could not comply with these rules as they ‘significantly interfere with the current distribution system’ in several ways (Interview 21. 16 September 2013). Notably, the City currently cannot measure and bill for time-of-use as existing meters do not measure consumption times. This creates an information gap whereby the Electricity Department does not have data on the actual times that large users are consuming electricity (CCT, 2013a; CCT, 2012g). According to the Head of Pricing and Regulation, modelling and pricing time-of-use would thus be a ‘thumb suck exercise which holds inherent revenue risk’ (Interview 21. 16 September 2013). Further, the Electricity Department has experienced technical problems with piloting time-of-use<sup>110</sup> and argue that time-of-use is difficult from a billing and administrative perspective which would place ‘additional burdens on a department with intense capacity constraints’ (Interview 21. 16 September 2013). Notably, according to the Electricity Department time-of-use would create cash flow problems (CCT, 2012g; CCT, 2013a). The Head of Pricing and Regulation explains that when utilities initially adopt time-of-use ‘customers don’t budget for it and hence cannot pay their accounts’. These cash-flow problems would be passed onto the City, which in turn ‘would struggle to pay Eskom for bulk purchases’ (Interview 16. 16 September 2013).

Third, there are cases where established rules can create complications when wider system variables change. An example of this can be found in the administration of FBE and its relationship to the rapid development of energy efficient technologies. This problem is summarised by the Head of Pricing and Regulation:

In the past, if a household consumed less than 450 units a month it was reasonable to assume that it was a result of lack of income and FBE policies were enacted according to these assumptions. Currently, electricity customers that sit within the upper level of the ‘Lifeline Tariff’ and entitled to FBE could very possibly be middle and high income

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<sup>110</sup> Where meters are incorrectly read or accounts are improperly billed

households that have undertaken extensive EE interventions. Generally speaking, these are not the customers to whom FBE is targeted to (Interview 16. 16 September 2013).

As indicated in previous chapters, the shift of middle and high income customers from being net subsidisers to being subsidised has severe revenue implications. Additionally, because FBE is based on consumption measured by a meter, a range of circumstances ensue whereby either poor households do not receive allocations or wealthy customers unfairly receive allocations. According to the Head of Green Energy,

it is common in informal settlements that more than one household are serviced by a single meter. This often results in their combined consumption exceeding 450 units. They therefore do not receive FBE and are charged higher tariffs. Then there are cases where customers receive FBE grants that are not entitled to it, such as people installing a separate meter in their garage, and the rest of the house runs off the house meter. Monthly consumption is then split and FBE is then received for both meters (Interview 16. 16 September 2013).

This example highlights the ways in which challenges emerge from established rules when rapid technology change occurs and the implications of technology change in Global South contexts where rules entrench and enforce development values.

#### 7.2.4. Rules and temporal disjunctures

During periods of embeddedness in the City of CT it became evident that there are considerable temporal disjunctures and time lags between regulations and technology in relation to transitions. These temporal disjunctures were present in almost every energy initiative the City had planned or was implementing. Figure 7.1 provides a broad outline of disjunctures between rules or technology in relation to various City energy initiatives. These were identified from observations and interviews with officials alongside an analysis of applicable regulation.

Temporal disjunctures between rules and technology take a number of forms. First, there are cases where rules attempt to regulate change in contexts where technology is not suitably mature. For instance, the Compulsory Norms and Standards (DME, 2008b) required municipalities to install ripple control devices<sup>111</sup> (CCT, 2011k; CCT, 2013a). The Electricity Department argued that they could not comply with this because 'reliable technologies for such a function do not currently exist' and that a number of technical conditions<sup>112</sup> had to be in place 'before implementation could occur' (Head: Green Energy. Interview 11. 04 December 2012). These top-down regulations accordingly

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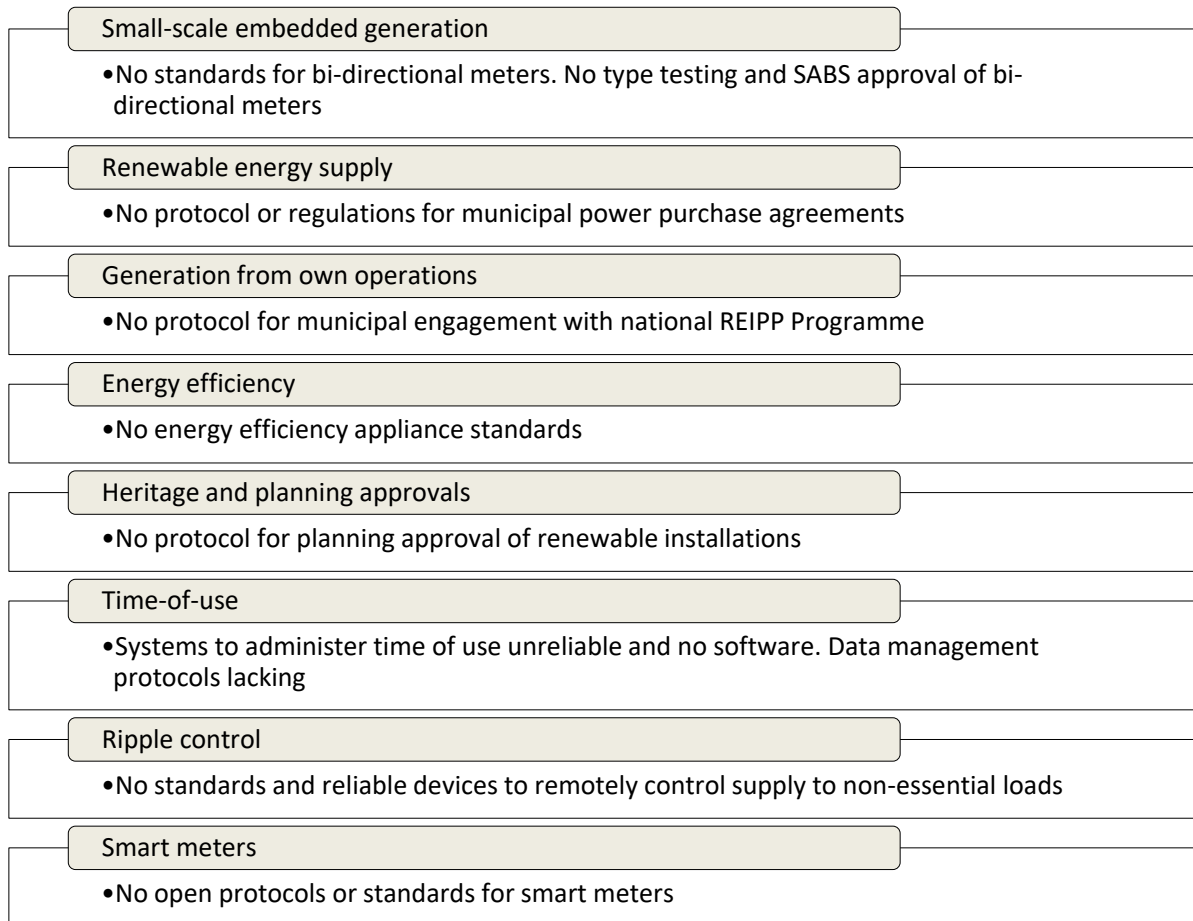
<sup>111</sup> To remotely control electricity supply to non-essential loads

<sup>112</sup> Regulator of Communications would have to ensure power line communication frequency spectrum promulgation and the Bureau of Standards would have to test the reliability of devices.



prematurely attempted to regulate change in an implementation landscape without mature technologies and technical pre-conditions.

*Figure 7.1: Proposed energy intervention and associated regulatory disjunctures*



Second, rules may dictate a particular technological patterning in implementation landscapes that lack appropriate systems or protocols. For example, the Compulsory Norms and Standards (DME, 2008b) directed municipalities to roll-out smart meters to large electricity users. According to the Electricity Department this would be problematic due to ‘an absence of appropriate open protocols that would allow smart meters to be rolled-out using equipment from multiple suppliers’ (CCT, 2013a). The associated risk of being locked into proprietary technologies is highlighted by the Head of Pricing and Regulation:

Being locked into a single supplier carries significant financial and technical risk and cannot be entertained for such critical systems. It would significantly interfere with the openness and integrity of the City’s metering infrastructure (Interview 16. 16 September 2013).

According to the CEO of GreenCape, the challenges from these rules partly stems from the fact that conventional distribution in the City used a single meter supplier model and was designed to

allow for one-way communication (GreenCape, 2012). Smart meters, conversely, would enable two-way communication between the City and the consumer and allow for multiple suppliers to connect to the grid (CCT, 2011k). Accordingly, national regulations were not properly aligned with the evolution of technology and failed to consider risks of a particular technological patterning on the City's electricity regime.

Third, there are many cases of regulations that required the City to roll-out novel technologies without provision for financing or capacity development. For instance, the roll-out of smart meters would place a significant financial burden on the City as it 'would need to replace 760 000 pre-payment and credit meters at a cost of approximately a billion rand' (CCT, 2012g). Implementation would also require significant re-training and up-skilling (CCT, 2013a). As highlighted by the Head of Green Energy:

We already suffer from capacity constraints – directions to install smart meters fail to plan or fund the needed capacity building efforts. Software for administering smart meters is unreliable and staff would struggle to operate such systems (Interview 11. 04 December 2012).

The regulations however give no provision for funding or direction on allocation of cost, resources and financial risk. The above highlights that in the City, funding, skills and management practices have developed around particular technologies, such as pre-payment and credit meter infrastructure, and institutional and investment decisions thus reinforce these technologies. Accordingly, there is resistance to manage the roll-out of different technologies, particularly without corresponding provision of resources to support new technologies.

Four, rules may require the roll-out of technologies without accompanying standards and testing. For instance, the Standard Conditions (NERSA, 2011a) instructed municipalities to facilitate SSEG. According to the Electricity Department it would be necessary to roll out bi-directional meters to facilitate SSEG (CCT, 2012d). However, there is uncertainty as to whether the City can legally install bi-directional meters in terms of the Distribution Metering Code (NERSA, 2007b). The Code (NERSA, 2007b) states that municipalities can only install metering equipment once it has been 'tested to determine if it meets supply utilities requirements and is based on international standards'. However, according to the Electricity Department 'there are currently no international standards or test records for bi-directional meters' due to the novel nature of the technology (Interview 21. 16 September 2013) resulting in inertia in implementation (CCT, 2013b; CCT, 2012e; AMEU, 2011).

The above cases, in general, highlight a misalignment between rules and technology change. They indicate that rules developed by national government, including NERSA, DOE and the Department of Trade and Industry, either struggle to keep abreast with technology change or regulate change

prematurely. It further highlights that rules developed to facilitate change, directed at implementing agents that do not have the means or guidelines to comply, creates inertia and further resistance to change.

#### 7.2.5. Regulatory coherence and implementation in the City of Cape Town

It is evident that the absence of coherent rules, ambiguity in mandates and regulatory gaps create uncertainties in implementation of transition initiatives. Across interviews and observations, officials expressed uncertainty around regulation on a wide range of matters including whether the City can set tariffs<sup>113</sup> contrary to national guidelines; use ripple control or roll-out energy services to poor private households. Figure 7.2 provides a list of regulatory uncertainties raised by City officials.<sup>114</sup>

This regulatory incoherence has a number of implications. First, it feeds a 'barrier narrative' related to socio-technical transition processes that is common in theory and practice. In ERMD considerable attention is paid to identifying and overcoming regulatory barriers to municipal energy and climate initiatives. Several reports have been drafted in this regard including reports commissioned by the City, such as 'Barriers to renewable energy and energy efficiency' (CCT, 2010f) and 'Regulatory Review: Promotion of Energy Efficiency in Municipalities' (CCT, 2013). Barriers outlined in these reports include provisions in the Municipal Finance Management Act (MFMA), 2003 which restrict long-term investments in renewable energy and EE and restrictions on the City entering into power purchase agreements or public-private partnerships (CCT, 2010f; NT, 2013c). However, it is evident that many 'regulatory impediments' in the City are not legal in nature. An example of perceived barriers in public finance legislation to a transition initiative provides a case in point.

During field-work many officials consistently maintained that a significant legal barrier to energy efficiency projects is a three-year limitation on tenders in the MFMA. According to a Senior Professional Officer in ERMD this limitation impacts on a range of efficiency projects including building retrofits (Interview 24. 16 August 2013). Building retrofits are commonly implemented by means of a shared-savings contract between a client and an energy service company (ESCO), where the ESCO pays the upfront capital costs of the interventions. The recipient of the interventions agrees to pay this capital back over an agreed period from the financial savings realised from the retrofit.

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<sup>113</sup> Including feed-in and time-of-use tariffs

<sup>114</sup> Table 10.1 in Appendix 4 further provides a comprehensive list of energy-related regulatory challenges raised by officials

*Figure 7.2: List of regulatory uncertainties mentioned by City of Cape Town officials*

<p>Power purchase agreements</p> <ul style="list-style-type: none"> <li>•Can the City enter into a PPA with an IPP?</li> <li>•Can the City sell excess generation to a customer outside the municipal license area?</li> </ul>
<p>Cost of renewable electricity</p> <ul style="list-style-type: none"> <li>•Can the City pay an IPP more for electricity than it pays for Eskom bulk purchases?</li> <li>•What is the definition of 'least cost' in the MFMA? Does 'least cost' include economic and environmental cost?</li> </ul>
<p>Generation licenses for renewable electricity</p> <ul style="list-style-type: none"> <li>•Can local government pursue renewable energy for reasons other than ensuring 'uninterrupted supply'?</li> <li>•Are there any caps placed on the amount a generator may produce in terms of own use or for a demonstration plant?</li> </ul>
<p>Electricity tariff development</p> <ul style="list-style-type: none"> <li>•Can the City set an electricity tariff in line with local urban socio-economic goals?</li> <li>•Can the City introduce an electricity surcharge to be used for RE and EE projects?</li> <li>•Can the City set a feed-in tariff in conflict with the NERSA guidelines?</li> </ul>
<p>Electricity supply contracts</p> <ul style="list-style-type: none"> <li>•Does Eskom have a legal obligation to supply the City with uninterrupted electricity? What is the City's right of recourse if Eskom does not supply?</li> </ul>
<p>Energy efficiency and demand-side management</p> <ul style="list-style-type: none"> <li>•What is the legal standing of Regulations for Compulsory Norms to the extent that it places constraints on ripple control?</li> </ul>
<p>Public funding</p> <ul style="list-style-type: none"> <li>•Can local government use public funding for expenditure on low income private households?</li> </ul>
<p>Billing systems</p> <ul style="list-style-type: none"> <li>•Can local government collect money on behalf of SWH suppliers or use its billing system to allow system owners to pay back?</li> </ul>

However, efficiency interventions can have relatively long payback periods and hence the contract period would usually exceed three years. Conversely, on reading the MFMA it is evident that the applicable section<sup>115</sup> does not set out an absolute restriction on contracts beyond three-years but

<sup>115</sup> Section 33

only require additional conditions to be met, including public participation. According to the Head of Energy and Climate Change:

Although the extension process requires additional steps - it is entirely reasonable and achievable. The institutional challenge stems from the fact that supply chain management is often cautious and wary of novel processes and tenders. Smaller municipalities with capacity constraints have found it difficult to manage a lengthier and more complex tender process. But it should not be a problem for Cape Town (Interview 23. 26 August 2012).

This highlights that the actual barrier is institutional rather than regulatory and that 'legal impediments' are often perceived, misinterpreted or used to justify a particular position. This demonstrates that although the regulatory system may enable transition initiatives, implementation is often constrained by the structures of organisations tasked with implementation. This is corroborated by De Visser (2012), Collier and Glazewski (2012) and Davison et al. (2015) that find that an overly cautious compliance-culture, enhanced by risks related to personal and criminal liability, rather than regulation create barriers to engage with transition action in the City of CT.

Second, regulatory uncertainties result in divergent interpretations and conflicts around the meaning of rules during implementation. Notably, it is evident that divergent interpretations are not a result of ambiguous language or framing in legal instruments. Rather, interpretations are guided by underpinning motivations related to, *inter alia*, organisational conditions, visions and regime values.

The implementation of ripple-control<sup>116</sup> highlights the manner in which interpretation of rules is underpinned by organisational conditions. In background, the City has a ripple control system that has been active for a long time in the city's eastern suburbs. Subsequently, national government introduced the Compulsory Norms and Standards (DME, 2008b) which stated that ripple control could only be used during 'capacity constraints to avoid blackouts' and only after a request from Eskom to municipalities to reduce demand. This placed limitations on the City's existing ripple control system. This consequently led to divergent interpretations within the administration between ERMD and the Electricity Department.

According to the Head of Protection and Measurement, the Electricity Department has limited will to continue ripple control for reasons related to 'costs, additional work and fear of resistance from customers' (Interview 21. 16 September 2013). Thus, the department interpreted the regulations

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<sup>116</sup> Ripple control involves relaying a high frequency signal across the grid to shut down non-essential appliances during capacity constraints.

alongside the Constitution and Consumer Protection Act, 2009 as prohibiting the City of CT from interfering with customer supply. This position is summarised by the Head of Protection and Measurement:

Ripple control has limited benefit for customers and customers are paying for the electricity and it is their prerogative to have electricity whenever they need it (Interview 21. 16 September 2013).

In opposition, the Energy and Climate Change Unit that promotes demand-side management argued that this interpretation was erroneous. Their position is highlighted by the Principal Engineer: Energy and Climate:

Distributors interfere with electricity supply on a daily basis, like during maintenance. Ripple control is a means for local government to manage load - as a distributor we are legally entitled and required to manage load. It is in the interest of the City and can reduce our operational costs. And, it would be in the interest of customers because it reduces risks of load shedding. The Constitution gives municipalities the power to use ripple control systems - NERSA has no authority to limit this (Interview 20. 23 August 2013).

The above demonstrates that interpretation of rules by different departments in the City is heavily guided by conditions such as organisational priorities, capacity, cultures and risks. Whereas the Utilities Directorate interpreted the rules in light of costs, risks and capacity constraints, ERMD interpreted the rules primarily in light of the benefits it may have for reducing electricity consumption and achieving targets in the ECAP.

Second, regulatory interpretations are guided by the underlying visions different social groupings have vis-à-vis the type of socio-technical regime they want materialised. This is evident in contestation surrounding City-led renewable electricity supply. In brief, the Electricity Regulations on New Generation Capacity (DOE, 2011d) state that new power stations may be established 'to ensure uninterrupted supply' and the MFMA states that local government has to buy electricity at the 'least cost'. These two provisions have led to different interpretations by ERMD and the Electricity Department.

On the one hand, officials in ERMD that advocate for energy autonomy argue that the regulations do not prohibit new generation for purposes other than 'uninterrupted supply' (De Visser, 2012). For example, the City could facilitate renewable generation in pursuit of low-carbon and diversification of supply and could thus be exempt from the regulations (SALGA, 2013a). ERMD officials further argue for a broader interpretation of 'least cost' which includes factors such as reduced load-shedding, price certainty, life-cycle assessments and even health and environmental externalities in quantifying 'least cost'. Such an interpretation would make renewable electricity

competitive and hence legally permissible. This interpretation is captured in a report on the 'Role of the City of Cape Town in energy generation':

A renewable electricity power station could offer the City lower priced electricity than a likely national grid price if not now then within five or ten years as Eskom increases the grid price to cover costs. In the medium-longer term, over the life of the power station investment, it is quite plausible that a significant quantity of power could be procured below the national grid price (CCT, 2011f: 3).

On the other hand, the Electricity Department, opposed to city-led renewable electricity, interpret these rules as meaning only national government can determine new capacity needs on strict 'uninterrupted supply' criteria and the MFMA provision means 'least cost' in strict financial terms. This requires municipalities to buy electricity from the national grid (CCT, 2011j; CCT, 2012h). In sum, this example reveals that competing visions of energy autonomy versus a centralised grid for cost sharing<sup>117</sup> informs and is contested in the interpretation of rules.

Third, it is evident that implementing agents interpret rules according to the underlying regime values to which they are aligned to and hence employ specific interpretations opportunistically to uphold these values. This is observed in circumstances surrounding a programme to roll-out ceilings in subsidy houses built without them.

On the one hand, the Finance Directorate has been hesitant to support the project due to compliance risks and thus adopt a specific regulatory interpretation to support this position (Meeting 25. CCT Finance Directorate, 07 September 2012). In brief, officials in the Finance Directorate interpret the MFMA as prohibiting expenditure of public funds on private property. The Director: Budgets, for instance, states that local government 'cannot in any way be involved in spending money on private property - once ownership of a subsidy house is handed over to a recipient it becomes private property' (Meeting 25. CCT Finance Directorate, 07 September 2012).

On the other hand, this project is supported by ERMD and politicians in the Energy Committee. Interestingly, this is an example of an alignment of regime values between social groupings that usually clash. These stakeholders argue that 'providing energy services to low-income households would not contravene public finance management rules'. This position is summarised by the Manager: Property, Environmental and Planning Law:

I have often expressed the view that expenditure on private property is not prohibited by the MFMA or the PFMA, as long as the expenditure is justified in some way as being in pursuance of a purpose which is within the statutory powers and functions of government and is budgeted for in the normal way, and the decision to expend the funds is made in a transparent and accountable way (Interview 25. 09 April 2013).

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<sup>117</sup> See Chapter 5

The above rationalises that public expenditure and the interpretation of public finance management rules has to be considered in light of the potential socio-economic benefits of a project and the underlying principle behind financial management regulation to prevent wasteful expenditure and excessive and corrupt privatisation (O'Sullivan, 2014).

Further, it is evident that divergent interpretations of rules amongst different departments lead to divergence in how solutions are framed. The example of a waste-to-energy project in the City of CT provides a good example. In background, the City has made commitments to implement waste-to-energy projects (CCT, 2010a). In managing this project, the Utilities Directorate resolved to follow a specific regulatory process in the Municipal Systems Act, 2000 and Municipal Public-Private Partnership Regulations (NT, 2005a) in order to enter into a public-private partnership where a private company would extract methane from a City-owned landfill (CCT, 2010e). In order to facilitate this, the Utilities Directorate procured the services of a transaction advisor. According to the Manager: Technical Strategic Support<sup>118</sup> the City is legally obliged to follow this approach and a transaction advisor was necessary 'in order to ensure that the City complies with the complex regulatory framework' (Interview 6. 30 September 2013).

Conversely, according to the Energy and Climate Change Unit, adopting this approach has resulted in serious delays in implementation. This is reflected in the below statement:

The landfill gas to electricity project has followed the wrong processes and still does. Solid Waste initially contracted with CEF to sell carbon from the project. I said don't do it, it is going to be too cumbersome. Then they followed a Municipal Systems Act process and it is highly unlikely that this is the right process. Then they spent millions on a transaction advisor although skills were available in-house (Interview 23. 26 August 2012).

Similarly, the Manager: Property, Environmental and Planning Law Unit said:

There is considerable uncertainty as to whether both the process for compliance with the Public Private Partnership Regulations and the Municipal Systems Act process need to be followed simultaneously or whether there is a means to streamline and simplify the procedure (Personal Interview 25. 09 April 2013).

On practical grounds the Director: ERMD held that methane emissions from landfills should rather be seen as an environmental management issue and the 'City should rather cap its landfill sites and flare the methane to prevent run away emissions' (Interview 1. 06 February 2013). This highlights that two separate departments have very different interpretations of legal rules and legal process, which in turn lead to different ways of framing a problem and solution. Whilst the Utilities

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<sup>118</sup> The lead manager of waste-to-energy projects



Directorate views landfill gas as an electricity generation opportunity, ERMD regards methane as an environmental hazard that requires urgent action.

#### 7.2.6. Bottom up responses from municipal officials

The City of CT is not a passive ‘receiver’ of top-down rules. It is evident that implementing agents scrutinise, interpret and negotiate top-down rules before implementation. Notably, officials identify potential problems for City systems and processes that could arise if rules were implemented according to the ‘letter of the law’ and then develop responses that differ significantly, in form, from top-down regulatory directives. These responses are often more suited to the City’s context. During field work numerous examples of this were evident. Five cases are outlined to distinguish the form of these responses.

First, several instances were observed of officials ‘side-stepping’ regulatory directives in order to mitigate risks. The background to implementation of a smart meter roll-out provides a strong example of such a response. In summary, rather than rolling-out smart meters in the manner dictated by the Compulsory Norms and Standards (DME, 2008b) with associated risks<sup>119</sup> the Electricity Department decided to provide support to national government and work with the South African Bureau of Standards in developing open protocols and standards to prevent lock-in to proprietary technology (CCT, 2011k; CCT, 2013a). The department argued that a smart meter roll-out should ‘only occur once the technology is mature with open communication protocols and local standards’ (CCT, 2012g) and sought to ‘time the roll-out of smart meters with the expiry of existing pre-payment meters rather than rushing in order comply with national regulation’ (CCT, 2011k). The rationale for this approach is further highlighted by the Head of Protection and Measurement:

We want to facilitate a coordinated roll-out, in collaboration with national government and in line with national demand-side management and grid investments. We must be careful with the next generation of meters as we can get locked into proprietary technology. The City has half a million pre-payment meters installed. These systems are reaching the end of their lifespan but will expire at different times. A gradual programme of replacement, spanning over ten years would be prudent (Interview 16. 16 September 2013).

In brief, the Electricity Department supported smart metering infrastructure but only from multiple suppliers based on open protocols and if prudently timed. Its approach took into account the ‘evolution of standards and financial and resource constraints’ (CCT, 2011k: 2) as well as the existing electricity regime structure. This sought to mitigate risks and potential negative impacts of top-down rules.

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<sup>119</sup> See Section 7.2

Second, it is evident that officials often attempt to develop ‘context-sensitive’ solutions in response to top-down rules. The example of SSEG provides a strong case of a response that is cognisant of local conditions. In response to challenges associated with net-metering<sup>120</sup>, the Electricity Department refused to implement the directives of the Standard Conditions (NERSA, 2011a). The rationale for this is repeated by the Head of Green Energy:

There is a need for regulation that provides for coherent implementation of SSEG in the future, which includes provision for a fair feed-in tariff. Particularly because increased uptake of distributed generation will create revenue loss and increase network costs.

Instead, the Electricity Department prioritised a more context-specific approach by proposing the use of a two-way tariff structure (Figure 7.3) and the use of bi-directional meters. In determination of the feed-in tariff the department calculated the average purchase price for electricity<sup>121</sup> and committed to paying net-metered customers this amount,<sup>122</sup> alongside charging a daily service fee aimed at covering the City of CT’s fixed costs (CCT, 2012c; CCT, 2012e; CCT, 2013c).

*Figure 7.3: City of Cape Town Net metered domestic tariff structure*

			2013/14 Excl. VAT	2013/14 Incl. VAT
<b>Net metered domestic:</b>	Service:	R/day	10.60	12.08
	Energy consumed:	c/kWh	88.82	101.25
	Energy generated:	c/kWh	46.04	52.49

Source: City of CT Draft Budget (2013/2014)

According to a presentation by the Head of Green Energy to the Energy Committee, the rationale for this tariff structure is cost reflectivity, revenue neutrality and the avoidance of an ‘unfair subsidy to wealthy customers whilst providing some incentive for renewable energy’ (CCT, 2013b).

This approach mitigates a number of challenges with rules formulated by NERSA. As customers are refunded at a lower tariff there is a financial incentive to shift load off-peak to coincide with generation (CCT, 2013c; CCT, 2012e; CCT, 2014b). According to an internal memorandum regarding this tariff structure, it would further mitigate risk of arbitrage practices, prevent revenue loss and ensure that the ability of the City to cross-subsidise the poor is not compromised (CCT, 2012c). This is an example of a bottom-up response that considers socio-economic context and provides an alternative solution to the otherwise detrimental implications of top-down rules. Notably it to some

<sup>120</sup> See Section 7.2.3

<sup>121</sup> 46 cents per unit

<sup>122</sup> The amount the City pays Eskom for bulk purchases during standard time - times when photovoltaic systems generate electricity.

extent, navigated tensions inherent in the City's electricity regime between environmental and development values.

Third, there are a number of instances where officials implement top-down rules but apply 'alternative' or additional processes. The implementation of time-of-use is such an instance. In response to the Compulsory Norms and Standards (DME, 2008b) the Electricity Department argued that it would be 'prudent' to undertake a cost-of-supply study before implementing time-of-use (CCT, 2011k). This would provide a proper understanding of the costs to supply various customer groups and the desirability of a time-of-use tariff. The rationale for this approach is outlined by the Head of Pricing and Regulation:

In implementing time-of-use it is necessary to extract as much data on the times when customers are consuming electricity and to then set tariffs accordingly. Setting a time-of-use tariff is dependent on data that can be gained through smart meters and other advanced metering infrastructure (Interview 16. 16 September 2013).

Further, in order to prevent cash flow problems, the Electricity Department proposed changing certain Eskom intake points to a time differentiated tariff to facilitate a proper time-of-use signal that can be transferred to customers (CCT, 2011k; CCT, 2013a). In sum, this bottom-up solution considered financial impacts, metering infrastructure, data and knowledge management in concert. This demonstrates cognisance of complexity in the City's electricity regime.

Four, a small group of officials have proposed an 'integrated' and planned reconfiguration process in response to incoherent top-down rules. In various Energy Committee meetings, the Principal Engineer: Energy and Climate promoted a reconfiguration process that includes the implementation of tariff reform, energy efficiency, smart metering, load shifting, ripple control, time-of-use and SSEG together, in a concerted manner (CCT, 2011i). According to the Principal Engineer, the coordination of these separate interventions would mitigate a range of risks that would ensue if they were implemented independently. For instance, the roll-out of smart meters would enable the City to measure time-specific information and set prices that are time differentiated, overcoming barriers to time-of use (CCT, 2011i). Smart meters would also facilitate ripple control and SSEG. Time-of-use would help to shift demand off-peak, which would provide an incentive for SSEG owners to match consumption with generation. Ripple control and energy efficiency interventions outlined in the ECAP (CCT, 2010a) such as the Mass Solar Water Heater roll-out would further shift consumption off-peak. Lastly, tariff reform, would reduce revenue impacts and ensure that 'the City is making money at certain times and saving money at other times and is still able to subsidise low-end users' (CCT 2011j).

Finally, there are examples of implementing agents in the City completely ‘resisting’ top-down rules. The City’s resistance to plans and attempts by national government to rationalise the municipal distribution industry is a pertinent example. These plans culminated in the Regional Electricity Distribution (RED) process, which proposed converting the many municipal distributors across the county into six independent Regional Electricity Distribution companies. The first company, RED1, was established in Cape Town. However, this was only on paper. In practice, the Electricity Department, the Finance Directorate, Council and the Mayor resisted the rationalisation based predominantly on the loss of revenue from surplus income from the sale of electricity.<sup>123</sup> The Association of Municipal Electricity Undertakings also opposed it, on behalf of the City of CT and other metropolitan municipalities, arguing that it infringed the Constitution by limiting municipal electricity distribution powers. This led to the collapse of RED1 in Cape Town and hindered future plans to restructure distribution. This highlights that top-down rules that seek to completely alter the structure and autonomy of local electricity regimes are fervently opposed by local regime members.

### 7.3. Discussion

#### 7.3.1. Rules frame regime stability and regime values

This chapter demonstrates that regulation plays multiple roles in shaping regime structure and function as well as regime reproduction and reconfiguration potentials. Kemp and Loorbach (2006) argue that rules provide stability to existing socio-technical systems. However, this chapter highlights that policy elites and regulators use the regulatory system as a tool to stabilise and structure socio-technical regimes, in a top-down manner, in a desired configuration aligned to an incumbent political economy. Rip and Kemp (1998: 340) outline a technocratic conception of regimes as a ‘rule-set of grammar embedded in a complex of engineering practices, production process product characteristics, skills and procedures’. In contrast, this chapter implies a conceptualisation of regime rules as instruments for exerting regime power. Thus, regulation is regarded as an apparatus to consolidate regime authority and a means to lock-in regimes and the particular modes of thought that underpin regimes.

On the other hand, this chapter shows that the regulatory system may also be used as a tool to stimulate regime change or reconfigurations to more sustainable domains. However, rather than merely ‘enabling action’ (Geels, 2004), this chapter shows that only when there is significant pressure for change, through politics and power struggles, are rules used to facilitate socio-

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<sup>123</sup> This was done through, *inter alia*, requesting NERSA to transfer the distribution licence back to the City, allowing a service delivery agreement to lapse, seeking legal opinion on the process and confirming the decision by a full Council meeting.

technical reform. In the language of the MLP, rules are thus conceptualised as a response to landscape pressures and may be construed as the codification of the response, alongside the underpinning rationale, to landscape pressures.

This opposing role of regulation in respect of regime stability and change has particular relevance to the relationship between regulation and innovation (niche technology). Where rules are intended to stabilise an incumbent technological configuration and concentrate control, they intentionally restrict uptake or create barriers to disruptive or innovative technologies. Conversely, as a tool for reform, rules are used to stimulate innovation or incubate niche technologies.

Third, this chapter finds that the regulatory system is used to entrench particular regime values within socio-technical systems during regime configuration and reproduction processes. In previous chapters it was argued that regime values underpin and are integrated into regime structures. The findings of this chapter indicate that the regulatory system is a principal tool for assimilating regime values into socio-technical regimes and enforcing these regime value sets. In brief, rules codify, entrench and stabilise the regime value sets, which underpin regimes.

Further, it is evident that this is not a process of codifying 'shared rules' (Geels, 2004). Rather different regime values are contested and compete for primacy in political and organisational arenas. Once a specific value set dominates or gains political prevalence it is codified in regulation and becomes integrated within regime structures. In brief, underlying and competing regime values result in regime 'value struggles', the outcomes of which are codified in rules. Following value contestation, rules are put in place to either govern change or reassert the dominance of existing regimes. Thus, regulation is used to either change regime values or codify dominant values. As demonstrated, this is not a static process whereby specific regime values are indefinitely consolidated. Rather, regime values are in constant competition and their codification is accordingly dynamic. This conceptualisation offers a fresh insight into the role of regulation in the co-evolutionary process of socio-technical configurations and reconfigurations. Notably, it applies a conflict theory lens to the conceptualisation of regime rule formation and change.

The findings of this chapter highlight that mandates or delegations, defined and codified in regulation, play a critical function in framing the potential for socio-technical transitions. Basically, formal rule delegations guide and assign responsibilities to 'regime members' (Rip and Kemp, 1998) or other social groupings to either implement transition processes or reproduce the status quo. Notably, legal mandates play a considerable role in structuring and bounding the nature and scope of capacity and capability to influence transitions. Further, mandates define the scale and context in which reconfigurations take place.

On the other hand, without a legal mandate, stakeholders are highly constrained and directionless in their ability to manage socio-technical change. Apart from an explicit lack of mandate, regulatory systems may also conflict or be unclear as to which actors or organisations have a legal mandate to influence reconfigurations. Thus, regime rules are often vague on who has the legal 'capacity and capability' (Smith and Grin, 2010) to act. However, it is evident that change agents and organisational actors actively pursue wider mandates to manage transitions and re-tool or re-interpret existing mandates in order to push reconfiguration agendas. In the language of the MLP, social groupings actively strive to increase their capacity to act. This highlights that capacity and the regulatory frameworks (mandates) that codify capacity are dynamic, malleable and influenced by both bottom-up advocacy as well as top-down landscape pressures.

This offers insights into debates both around agency (Smith and Stirling, 2008) and the identification of the various types of rules 'constraining or enabling actions' (Genus and Cole, 2010). In brief, mandates partly constitute capacity and capability to act. Mandates provide a structure for the implementation of steps towards regime change but are also contested and allow for 'strategic manoeuvring' (Geels, 2004).

### 7.3.2. Regime rules and urban transitions

Späth and Rohrer (2012) argue that many regime structures are beyond reach of the city which in turn constrains the capacity for local government to transform socio-technical regime. Further, urban transition theory is replete with identification of regulatory constraints to municipal-led transitions. This chapter elaborates by explicitly highlighting the obvious; that national regulatory systems usually correspond with nationally configured socio-technical systems. Basically, the historical configuration of regulatory and institutional capacity along nationally bounded socio-technical systems limits urban transitions. Accordingly, the regulatory system is commonly used as a tool to reproduce centralised control of network infrastructure that is nationally bounded as well as the political economy and regime values that underpin national socio-technical network infrastructure.

In preceding chapters, it was argued that municipal functions and structures are aligned to and are somewhat extensions of large socio-technical networks. This chapter demonstrates that this entanglement makes urban transitions more difficult to navigate where urban transition agendas do not align with or negatively impact on the mode of thought, regime values or the political economy embedded in nationally configured socio-technical regimes and regime policy reconfiguration agendas. On the other hand, this chapter demonstrated that rules provide a means to align regime and 'territorial priorities' (Hodson and Marvin, 2010: 483). In this way, rules provide

a mechanism for the 'mutual constitution of socio-technical regimes' (Hodson and Marvin 2010: 481) between national socio-technical regimes and cities. This chapter elaborates that rule alignment between 'regime and territorial priorities' is facilitated or expedited through some form of shock or landscape pressure. In the City's case a supply and financial crises confronted by the national utility acted as such a landscape pressure. National government responded by relaxing rules and regulation that only allows the national utility to be involved in energy supply, providing some space for cities to be involved in generation. As such the regime priority, to ensure uninterrupted supply, and the priorities of urban policy networks, to strive for resource securitisation and autonomy, were aligned and facilitated by relaxation in rules.

A common theme in both urban transition theory and practice is the replacement of centralised, top-down national policy-making for more 'diffuse policy-making structures and process stratified across subnational, national and supranational levels of government' (Loorbach, 2010: 161). Urban transition analysis highlights the international trend of increasing authority being devolved to local government. This is supported by this chapter. However, it is evident that this devolution of power is facilitated by a multi-layered set of circumstances including landscape pressures on national socio-technical regimes, bottom-up lobbying by urban policy networks and deliberation around aligning territorial priorities, whereby the modes of thought, regime values and political economies of national regimes are maintained to some extent.

Third, related to the above, this chapter illustrates that the mandate of cities to define urban transitions is influenced by a number of factors including its relationships amongst spheres of government, the extent of pressure for change exerted by urban actors and external shocks. Urban transitions and their relationship to national socio-technical trajectories are accordingly heavily influenced by the alignment and communication, or lack thereof, between levels of government. As such the status and progress of urban transitions differ across cities (Hodson and Marvin, 2009b) depending on the regulatory status of cities and its relationship and alignment with higher spheres of government. Further, it has been demonstrated that local government may be able to re-shape socio-technical systems through using existing mandates and responsibilities in creative and novel ways. These key areas of influence can often be retooled and adapted to carry out broader transition goals and influence socio-technical reconfigurations that are only partly under their control.

In brief, the regulatory system provides the framework in which urban socio-technical change is possible. Top-down rules may constrain or enable urban transitions depending on the intentions and plans of regulators and policy elites, the lobbying power of different interest groups (including urban policy networks) and external shocks and pressures. Cities can accordingly develop transition

initiatives that differ from national transitions (Hodson and Marvin, 2010) only if the regulatory 'space' is provided or actively shaped to provide for such initiatives.

### 7.3.3. Rules and interference with regime logics and functions

The previous section highlights that regimes are structured and stabilised by rules. However, as Geels (2004) states, regimes are 'a semi-coherent set of rules'. This chapter elaborates on the relationship between rules and regime coherence. It is evident that regime coherence is facilitated by rules, whereby regulation is a mechanism for aligning the various sub-systems (or elements) of a regime, in order to weave a 'seamless' whole. This alludes to the prerequisite of a systems approach (Ebbesson, 2010) to regulating coupled socio-technical regimes if regime coherence is sought. On the other hand, in practice it is evident that regime members, policy elites and regulators are semi-coherent or piecemeal in regulating socio-technical regimes; in regulating both regime stability and change. This prevails due to contested priorities and absence of appreciation of the functioning of whole systems and the interactions of various sub-systems. As a result, a range of tensions arise. In brief, this chapter highlights that regulation developed in a top-down manner aimed at facilitating socio-technical change result in tensions if they do not align with internal regime logics, interfere with regime functions or destabilise regime values, all of which are integrated into a regime structure. Each of these requires further elaboration.

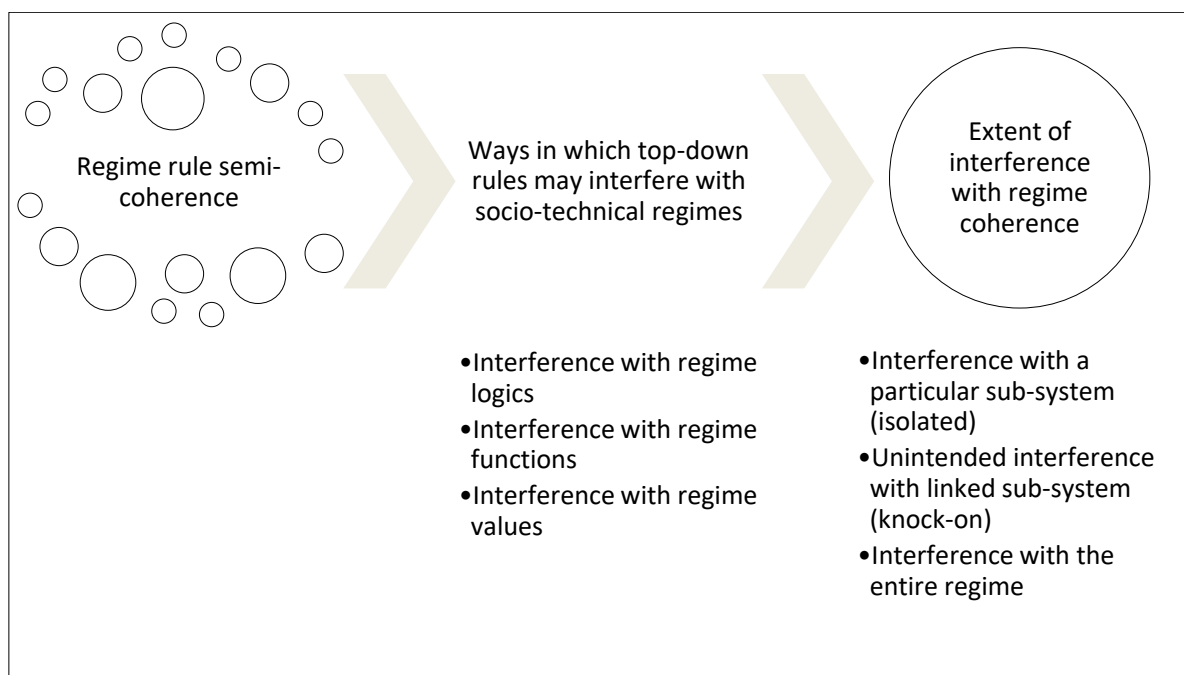
First, it has been demonstrated that an incoherent regulatory system, whereby underlying regime logics are not properly considered or coherently integrated into rule instructions, may contribute to regime rupture or collapse. This is demonstrated in the City's case by national regulatory frameworks that instructed municipal small-scale embedded generation without considering and including safeguards related to the impacts on an underlying revenue and business model based on increasing sales (regime logics). As argued earlier, municipalities may be regarded as extensions of the regime logics of wider socio-technical networks. Thus, this regulatory incoherence, from national regulators and policy elites, fail to understand these logics. Related to this, it is evident that top-down rules may impact on regime functions such as ensuring reliable supply of network services.

Moreover, this chapter presented examples of the ways in which top-down rules, based on new and emerging regime values may interfere with incumbent regime values. This builds on a conceptualisation of regimes as systems of values codified in rules. This case highlights that rules developed in order to promote regime reconfiguration based on environmental values can potentially negatively impact on development values integrated into the regime.



The above identifies three different categories of rule interference or semi-coherence. It is further evident that the extent of interference of top-down rules on regime logics, functions or values may differ. First, regulation may interfere with a sub-system (element) of a regime. Second, regulation intended to change a particular sub-system of a regime may have unintended consequences or impacts on another linked sub-system. The example of impacts of time-of-use and net metering tariffs on the City's administrative system is such an example. Third, regulation may impact on the entire regime and associated regime values, functions and logics that underpin such a regime. Inversely, established rules can create complications when wider system variables change.

*Figure 7.4: Regulatory interference with socio-technical regimes*



#### 7.3.4. Temporal disjunctures between rules and reconfigurations

A central thesis of socio-technical transition theory is that during regime configurations or reconfigurations, technological, institutional and legislative elements co-evolve and assimilate into a functional whole. However, this chapter highlights that this co-evolution process is asymmetrical and not often synchronised. Geels (2002: 1260) suggests that 'at times there can be misalignments between the different rules'. Notably, this chapter elaborates that rules are seldom aligned with technologies. This chapter presents a number of cases of top-down rules, promulgated by national government, that were not properly synchronised with technological and technical progress<sup>124</sup>.

<sup>124</sup> See Section 7.2.3

Further, it is evident that a number of types of temporal disjunctures (or misalignments) are apparent.

First, rules may attempt to regulate change, in contexts where technology is not suitably mature or technical pre-conditions are not in place to enable compliance with such regulation. These may be referred to as 'premature regime rules'. Second, rules may dictate a particular technological patterning in implementation landscapes that lack appropriate standards, testing, systems or protocols. Third, rules may dictate the roll-out of redundant or obsolete technologies or technologies that do not align or create risks for the incumbent socio-technical structure. These may be referred to as 'obsolete regime rules'. Four, regulations may dictate the roll-out of technologies without provision for financing or capacity development.

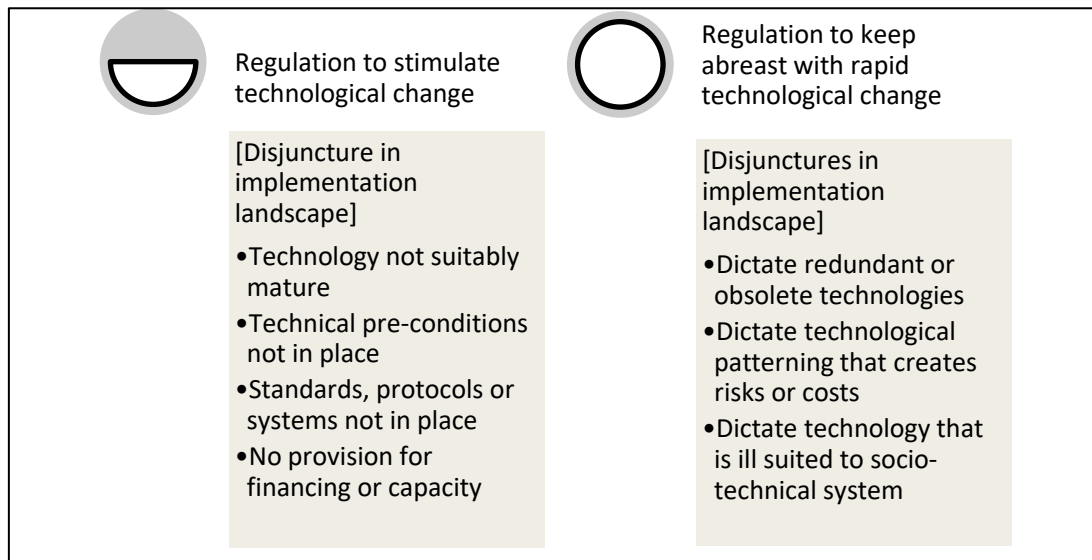
With regards to the latter, it is evident that rules that aim to facilitate socio-technical change are restrained in contexts where significant resources and structures (including financial, management, political and institutional) support an incumbent regime. Thus, the ability of rules to facilitate socio-technical change appear to be limited if they do not co-evolve with financial and institutional structures around niche technologies. Phrased differently, despite regulatory instruments that support socio-technical change, niche innovations may nevertheless struggle to 'breakthrough' without requisite funding, human resource and institutional structures in place.

Further, this chapter highlights that regulation either aims to change the status quo (regulate change) or provide rules for an already existing situation (regulate the status quo). During the latter process rules attempt to keep pace with and regulate a material situation. In the former it aims to change a material situation. In both cases there is not a stable and synchronised alignment between rules, institutions and technology. This offers insight into the timing of configuration and reconfiguration processes and contributes to our understanding of the co-evolution and alignment between rules on the one hand and institutions and technology and the manner in which these are weaved into a 'seamless web' (Rip and Kemp, 1998). This recognises an innovation-regulation paradox (Dewick and Miozzo, 2002) in relation to socio-technical systems whereby innovation shifts the status quo and regulation attempts to standardise and mainstream innovation.

Notably, this chapter demonstrates that during periods of novel and rapid technological change rules cannot keep abreast with the rate of dynamic change. This to some extent reconciles ideas grounded in innovation-framing regulation with the MLP. In particular it suggests that 'extensive, rapid and technically complex innovation is inevitable' (Ford, 2013: 77) and the regulatory system is by and large unable to manage or direct innovation. Thus, the evolution of technologies would usually tend to dramatically precede regulation in the co-evolution of socio-technical regimes.

Importantly, this misalignment results in policy spaces without rules or incoherent rules, which in turn create uncertainty and inertia for planned reconfiguration processes.

*Figure 7.5: Temporal disjunctures between rules and reconfigurations*



The above also has a bearing on our understanding of temporal markers of transitions. Various sustainable transition case studies view ‘rule change’ through the introduction of legislation as an end of a transition or marker that a transition has occurred (Genus and Coles, 2008). Conversely, the findings of this chapter highlight that ‘rule change’ is merely part of the transition process, whereby struggles, misinterpretations and negotiations occur during planning, implementation and driving transition initiatives. As such it is argued that rule-change in relation to socio-technical regimes are not appropriate markers of an end point of transitions but should rather be conceived as part of a co-evolutionary transition process. This builds on Chapter 5<sup>125</sup> that presented a framework to analyse the temporal dimensions of sustainable transitions.

### 7.3.5. Regime rule contradictions in organisational settings

The preceding sections by and large deliberated on the ways in which top-down rules stabilise and structure socio-technical regimes and the interplay between regime rule coherence and misalignments during socio-technical configurations and reconfigurations. This section discusses the ways in which rules are produced and reproduced, refined (Geels, 2002) and modified in organisational settings. This seeks to provide insight into debates related to the ways in which regime rules are shaped, modified and adapted through processes of negotiation between social groups (Rip and Kemp, 1998) particularly within implementation (or lack thereof) settings.

<sup>125</sup> See Section 5.3.4

This chapter provides insight into the 'rules as barriers to transitions' narrative (Painuly, 2001). A common theme in transition theories in general and energy transitions in particular is identifying and unlocking regulatory barriers. Within this narrative regulation and social groupings that uphold these regulations are regularly regarded as barriers to environmental transitions. In the City for instance, rules that entrench and enforce developmental regime values such as cross-subsidy systems, redistribution and sound financial management are regularly viewed by ERMD as barriers to sustainable energy initiatives. This chapter challenges such a narrative. It finds that regulatory barriers are perceived, misinterpreted, created or opportunistically used to justify a particular position. Importantly, a perception of barriers depends on the positionality, cognitive rules, norms and regime values that particular actor's hold or their vantage point. This conceptualises regime rules and associated interpretations and perceptions of barriers as socially constructed by different social groupings and driven by value struggles. This offers a more nuanced conception than a 'barrier narrative' on the one hand and a less rigid structuralism inherent in the MLP on the other (Geels, 2004). This, to some extent, is a more constructivist (Genus and Coles, 2008) understanding of the relationship between regimes, values, rules and institutions.

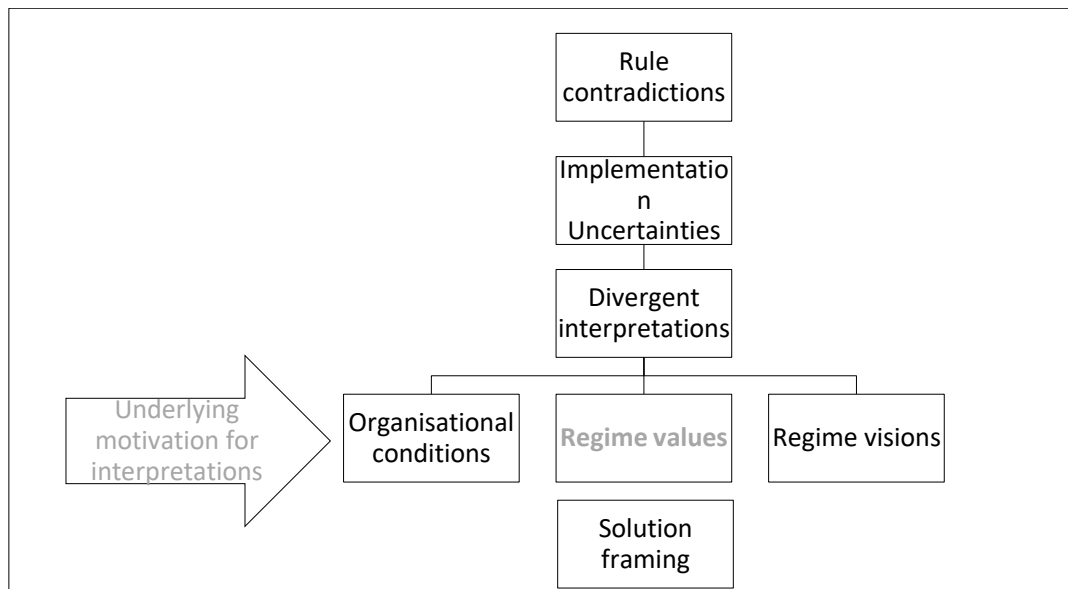
This chapter provided several examples of the ways in which rules, promulgated by national government (regime members and policy elites), aimed at regulating regime stability or reconfiguration initiatives related to urban electricity regimes, were inconsistent, unclear and contradictory. It is evident that these contradictions, lacunae and caveats create uncertainties that in turn create openings for divergent interpretations. Several cases of divergence interpretations of regime rules were demonstrated. However, these divergent interpretations are not based solely on misunderstandings but are rather underpinned and driven by organisational conditions and priorities, contested reconfiguration agendas and visions, and competing regime values embedded in different institutional cultures. This requires further elaboration.

First, it has been demonstrated that implementing agents interpret rules according to underlying organisational conditions such as cost, capacity and risk. Thus, ambiguity in rules is used opportunistically by actors in order to align and shape rules according to existing organisational conditions. Notably, rule contradictions are used by organisational units that support the regime as a justification for non-implementation of rules that would impact on the structure and function of the incumbent regime. Second, it is evident that implementing agents interpret rules according to their visions and reconfiguration agendas of a particular socio-technical patterning. If implementing agents support a particular reconfiguration vision, they adopt a broader interpretation of regulation in order to motivate their actions. Conversely, where implementing agents do not support such a vision, an excessively strict interpretation is put forward as a justification for refusal to implement.

Notably, this chapter demonstrated that implementing agents interpret and act upon rules according to the regime values that they hold and to which they are institutionally aligned. If implementing agents seek to protect the incumbent regime and the regime values that they uphold then they interpret rules conservatively or completely ignore rules. This has particular manifestations in Global South contexts, whereby top-down rules that impact on regime developmental values would tend to be sidestepped by regime members. Conversely, if socio-technical change is sought, rules are interpreted liberally and opportunistically. As previously highlighted, rules themselves stabilise and enforce specific regime value sets and hegemonies. This builds on previous arguments on the codification of regime values within regime rules. In essence regime values are codified and entrenched by top-down rules and then re-interpreted by regime members, from the bottom-up, in order to safeguard regime coherence. Thus, regime values are enforced by top-down (Geels, 2002) regime rules and reinforced by bottom-up refinements that occur during rule interpretation processes.

Finally, this divergence of interpretations of rules amongst different social grouping, driven by organisational conditions, contested visions and competing regime values, lead to radical divergence in the ways in which problems and solutions related to socio-technical configurations are framed, communicated and conceptualised.

*Figure 7.6: Regime contradictions and interpretations*



The above further contributes to debates on the extent to which regime rules are impenetrable to change (Rip and Kemp, 1998), agency (Smith and Stirling, 2010) and the ‘making and unmaking of rules’ (Genus and Coles, 2008). It has been demonstrated that regime rules are interpreted, negotiated and transformed by implementing agents that actively create, adapt, produce and

reproduce rules through their actions and use and interpret rules to justify their decisions and actions (or lack thereof). Notably, rules are reproduced or changed through processes of contestation between different social groupings within public niches. Thus, it is possible to say that the interpretation and implementation of formal regime rules are informed and driven by normative and cognitive rules (Geels, 2004) that are institutionally shaped.

It is evident that through these processes of negotiation and contestation certain interpretations of rules and the concomitant way in which solutions are framed, solidify and become dominant. This demonstrates a quasi-evolutionary sensibility whereby interpretations of rules enter into a fitness landscape (Kemp and Loorbach, 2006) and 'ones that work' are solidified. This further provides insights into the co-evolution of rules with other regime elements. In the preceding sections misalignments between rules on the one hand and technology and institutions on the other were shown. Refinements and modifications to regime rules, during interpretation and implementation testing, is thus an important process in the establishment of regime coherence (Geels, 2004) and weaving a 'seamless web' (Rip and Kemp, 1998).

These processes of negotiation and contestation around regime rules in municipal settings moreover influence the coordination, scale and potential of urban socio-technical transitions. Notably, contestation around regime rules impacts on capacity and capability to act and creates inertia in socio-technical transitions, particularly when there are misalignments or inconsistencies between national and urban regime values or 'territorial priorities' (Hodson and Marvin, 2010) that are manifested in regime rules.

#### 7.3.6. Bottom-up responses to regime rules

As highlighted above, it is evident that implementing agents are not passive recipients of regulatory instructions. Rather, they interpret, lobby, ignore, resist and change rules through practice. Thus, regime rules are co-shaped by interactions between regulators, policy elites and different social groupings within 'public niches'. This section elaborates that, based on findings in the City it is evident that in response to top-down regime rules, implementing agents devise bottom-up responses that are more suited to context, internal regime logics and the regime values that are embedded in socio-technical regimes. In this section, different strategies that implementing agents employ in response to top-down regime rules and the concomitant threats to the incumbent regime that such rules may impose, are discussed and classified.

First, this chapter demonstrated that implementing agents may devise and coordinate an implementation strategy for an isolated intervention and such strategy incorporates the solution to an otherwise detrimental impact that an isolated intervention could potentially have had on a

regime sub-system. This could be termed a 'side-step response'. The bottom-up response to the challenges around smart meters<sup>126</sup> is an example of such a response. In such a response implementing agents are prudent and seek to mitigate the risk that rule instructions may have on a sub-system of a regime. The response to rules is based on knowledge of the whole socio-technical regime.

Second, implementing agents may adopt a 'context sensitive response'. In such a response implementing agents devise an implementation strategy that differs and is more attuned to context than the rule instruction dictated by top-down rules. The strategy achieves the similar goals to the regulatory directive but avoids potential negative impacts on a regime sub-system. Third, this chapter outlined what may be referred to as an 'alternative response' whereby implementing agents adopt a similar, but more refined strategy, that is cognisant of the entire system, for achieving the same objective outlined in top-down rules. A bottom-up response to successful implementation of time-of-use<sup>127</sup> proposed by implementing agents is an example of an alternative response.

Four, implementing agents may respond in ways that are highly cognisant of the complexity and interrelatedness of the elements of a system and associated functions. This could be termed an 'integrated response'<sup>128</sup>. The overall goal of such response is to ensure optimum benefits are gained and risks and otherwise detrimental impacts are avoided that could arise from piecemeal interventions and rules that prescribe such interventions. Such a bottom-up response seeks to coordinate and synchronise a range of interventions that together mitigate the otherwise detrimental impacts of an isolated intervention directed by top-down rules. This response loosely approximates to the sensibilities of an integrated sustainability transformation described in the preceding chapter. Finally, it was shown that implementing agents may completely oppose and resist an intervention where it proposes a comprehensive restructuring of the regime. This can be termed a 'resistance response'.

In the above, it appears that the magnitude of the response has a direct relationship to the magnitude of the impact an intervention may have on an element of or the entire regime. When the entire regime is threatened by a top-down rule, the reaction is strong. However, such a reaction may be creative (integrated) or conflictual (resistance).

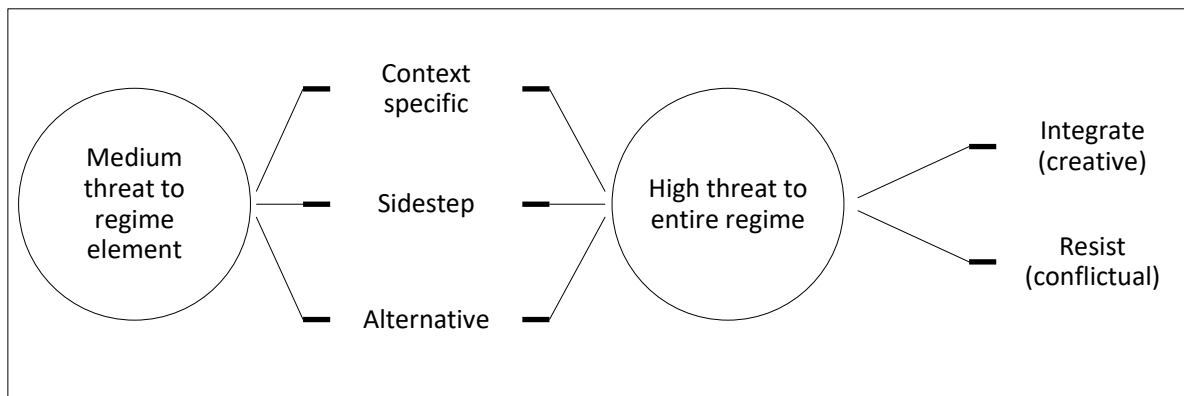
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<sup>126</sup> See Section 7.2

<sup>127</sup> See Section 7.10.4

<sup>128</sup> See Section 7.10.5

Figure 7.7: Classification of bottom-up responses to regime rules



This chapter highlights the frictions between top-down regime rules and the complex environments in which implementing agents operate. Regulators and national government agencies aligned to an incumbent regime tend to adopt a command and control style of rule-making and commonly seek to replicate best practice transition initiatives from the Global North. Conversely, implementing agents appear to act creatively in ‘compliance’. Several characteristics of this approach are evident.

Importantly, implementing agents act in a context-sensitive manner by developing context-specific responses to rules, adapting international standards to local needs, interpreting and adjusting rule systems to suit contextual priorities and through lobbying rule-makers for increased mandates to implement according to local contexts. In general, this indicates a rejection of North-South technical transfer and best practice in relation to socio-technical reconfigurations. Rather, it is evident that implementing agents consider a range of perspectives, options and multiple potential pathways to more sustainable domains. Related, implementing agents appear more cognisant of complexity and the interrelated nature of regimes and mindful of the values embedded in socio-technical regimes. Thus, it is evident that grounded responses often emerge from within organisations that are closely associated with regime reproduction. This is partly due to the intimate knowledge of regime structure, function and logics that such ‘regime members’ hold.

#### 7.4. Conclusion

The aim of this chapter was to elaborate on the relationship between regulation and socio-technical regimes. The chapter demonstrates that regulation has many functions in the ‘making and unmaking of regimes’. First, regulation consolidates power and is used as a mechanism to lock in regimes. On the other hand, regulation may be used as a tool to guide and initiate regime reconfiguration. Regulation can accordingly be regarded as a structural framework in which transition action is enabled or constrained. Thus, rules are both enabling, in that they offer certainty, legitimacy and guidance to specific transition actions, and constraining.



Second, this chapter demonstrated that values underpin both regimes and associated regime regulations. In essence, rules are used to entrench and stabilise specific value sets or hegemonies. During socio-technical configuration, reproduction or sometimes reconfiguration processes, the regulatory system is used to entrench particular agendas within regimes. Different values and interests are contested and negotiated and compete for dominance. Once a specific value set dominates, it is codified in regulation and integrated within regime structures. Such an understanding of regulation is well suited to the quasi-evolutionary conceptual underpinning of socio-technical system thinking, in understanding how regimes are locked in. Related, this chapter found that regimes rules are often incompatible with implementation settings as they may contain and codify opposing values to implementing agents. Organisational actors, correspondingly, interpret rules according to the value systems to which they are aligned.

Third, this chapter explored the ways in which regulatory instruments interfere with linked and coupled subsystems of a regime or regime logics and functions. It was found that the complexity of socio-technical systems does not lend itself easily to prescriptive rules that neglect the 'whole system'. Accordingly, rules, aimed at regulating change, often interfere with coupled subsystems of socio-technical regimes. Further, it found that the co-evolution of rules, technology and social change is not perfectly synchronised. Notably, rules often lag behind changing technological and institutional conditions or attempt to impose change prematurely. This disjuncture in turn impacts on the pace and feasibility of regulating socio-technical regime change.

Finally, this chapter identified, categorised and discussed the bottom-up responses to top-down rules. In brief, bottom-up responses to rules tend to be context specific, adaptive, creative, system-based and in line with regime values that implementing agents hold.

In brief, a central finding of this study is that the relationship between rules and socio-technical systems can be understood and analysed in terms of multiple themes. Regulation can be regarded as a structuring component of regimes. Rules can be perceived as a framework in which capacity to act is constituted. Rules can be seen through the lens of 'barriers and opportunities' for regime change or rather a structure in which agency, action and contestation are practiced. Finally, regulation can be analysed in terms of opposing forces; a top-down directive aimed at control and bottom-up responses aimed at asserting agency.

## Chapter 8: Organisations and transitions

### 8.1. Introduction

The aim of this chapter is to evaluate the role of local government and the organisational and political conditions within municipalities on socio-technical transitions. This involves an exploration of several organisational sub-themes that have been largely neglected in sustainable transition theory despite contributions by Smith *et al.* (2005) and Rotmans *et al.* (2001). This builds on Chapter 6 which conceptualised sections of the state as ‘public niches’ that are intimately involved in the maintenance and reproduction of regimes. Whilst Chapter 6 engaged with the governance of socio-technical transitions focused on networks of local actors in polycentric governance, this chapter hones in on the state (local government).

This chapter seeks to engage with the organisational level, specifically the organisational conditions present within municipalities and the impacts of these conditions on shaping, restricting or influencing socio-technical transitions. The investigation has a number of connected foci. First, it seeks to explore the relationship between organisational functions and transitions. This is empirically explored through evaluating divergent functions in the City with a particular focus on operational versus strategic planning functions. This has wider relevance to understanding the relationship between organisational and system function. Second, organisational structures of key regime organisations and their impact on enabling or restricting transitions are explored. Third, organisational cultures that are present and typical of different departments and line functions are examined, in relation to the impact these organisational cultures have on transitions. The exploration of organisational conditions seeks to apply classifications and conceptual models developed in more traditional organisational theory to the City’s energy transition and thereafter reconcile said concepts with transition theories. Notably, this enquiry seeks to build on arguments fleshed out in preceding chapters related to regime values, by examining the extent to which specific line functions or departments are aligned to different socio-technical regime values and the ways in which these regime values are contested, driven and prioritised in the City.

Thereafter, this chapter investigates the dichotomies and interplay between organisational risk and innovation. In this regard, types of risk experienced by the City in relation to socio-technical change are identified and examined. This informs discussion on reflexive forms of governance, introduced in Chapter 6, that stress the importance of innovation ‘space’ for managing change and the relevance of such innovation-based modalities for municipalities in the Global South.

The final section of this chapter briefly engages with the broader issues of politics, policy and power. An investigation into politics, power and policy is part and parcel of an organisational enquiry for a number of reasons. Notably, local governments are substantially structured and modified around local and national political processes. Further, specific political phenomena, notably electoral cycles, representative democratic structures and the interplay between administrative and political structures, have a considerable bearing on transition processes. Nevertheless, these themes have been neglected in the MLP apart from notable contributions from Voß and Bornemann (2011), Scrase and Smith (2008) and Lawhon and Murphy (2011). Notably, Voß and Bornemann's (2011) framework distinguish between policy (problems and solutions of politics), polity (structural aspects of institutions) and politics (interactions between divergent stakeholder groupings).

Regarding power, this chapter identifies and examines the ways in which different social groupings in the City of CT exert power and the impact this has on transition processes. When regarding politics, this chapter investigates political conditions and phenomena that impact on transition processes across both spheres of government (national government and the City) and politics within the City, particularly interactions between politicians and officials.

## 8.2. Results

### 8.2.1. Organisational function of local government

It is evident that there are essentially two 'camps' in the City defined by their function. On the one hand, there are the operational departments that are fine-tuned to service delivery and provide and maintain complex network services and infrastructure including water, storm-water drainage, sanitation, waste and electricity. The City Council Overview (CCT, 2011b) highlights that the bulk of this operational function is housed in the Utilities Directorate<sup>129</sup>. The objective of operational departments is to 'keep services running based on tried and tested processes' (Interview 11. 04 December 2012). These departments have large capital and operating budgets (CCT, 2012b). The services they provide form the backbone of the traditional and regulated<sup>130</sup> function of local government and the bedrock of City revenue, generated by raising electricity and other service charges (CCT, 2012b; CCT, 2011f).

On the other hand, there are smaller and more strategically-focused planning units. These have arisen more recently from the widened mandate of local government (Collier and Glazewski, 2012; Cartwright et al., 2012). The function of these units is to drive complex and often ambiguously defined services and agendas such as local economic development, resilience, climate mitigation,

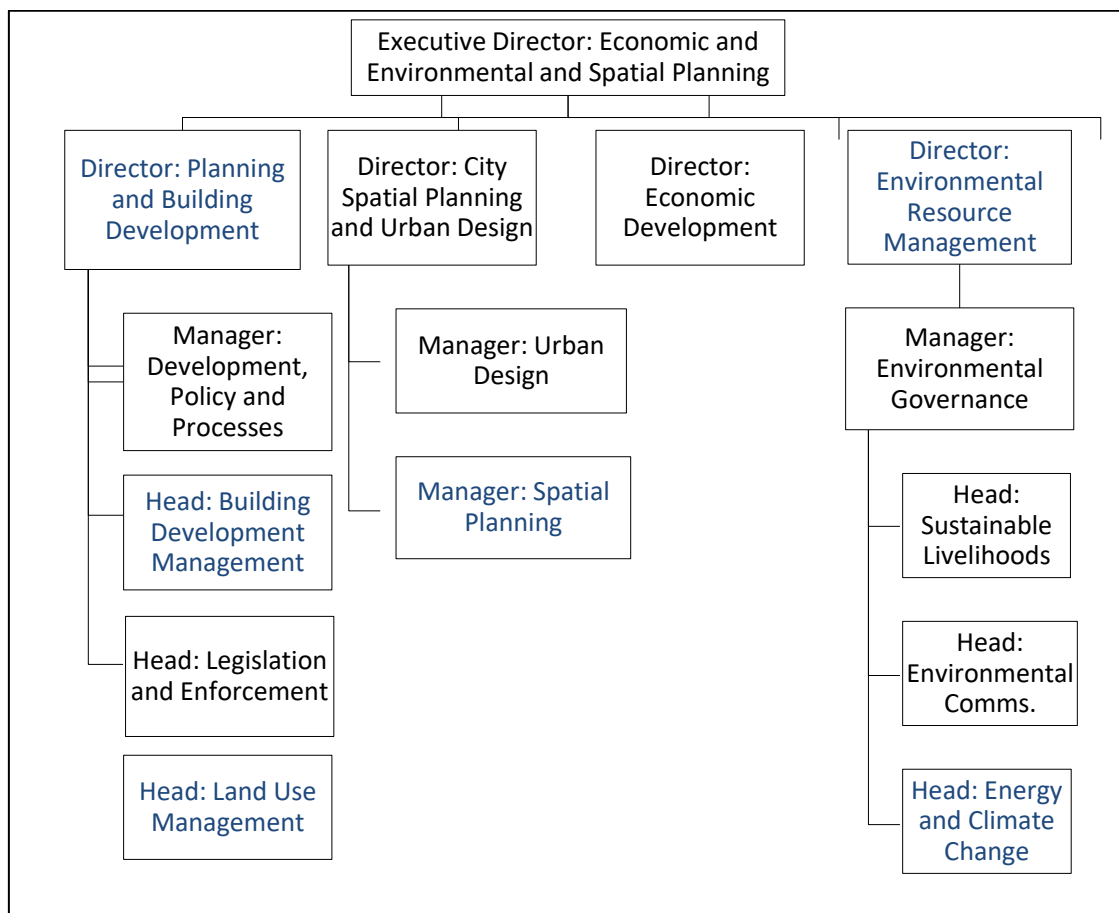
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<sup>129</sup> See Appendix 3 for Organograms of City administrative structures

<sup>130</sup> In terms of the Municipal Systems Act, 2000 and Municipal Structures Act, 1998

energy security, resource efficiency and disaster risk management (Davison et al., 2015; Taylor, 2016; Lewis and Jooste, 2012). The Strategy and Planning Directorate, later restructured as the Economic, Environmental and Spatial Planning Directorate (EESP), was in effect established to house these functions (CCT, 2011f; CCT, 2007b).

Figure 8.1: Organogram of Environmental, Economic and Spatial Planning Directorate



Source: Organogram developed from information on CCT, SAP Portal/eServices

In respect of these complex functions there is generally an absence of clear mandates to fulfil these objectives and these units have limited budgets (CCT, 2012b), resources and capacity (Taylor, 2016; Cartwright et al., 2012; Davison et al., 2015). According to the Principal Engineer: Energy and Climate:

In the case of electricity planning, local economic development and an externality like climate change, the City, and to some extent national government, have recognised that municipalities have a role to play there. The thing is that the City hasn't made the structural changes and resource allocations necessary to give effect to these overall policy decisions that say that local governments need to play a role. Nor have they properly defined the role (Interview 20. 23 August 2013).

The *modus operandi* of these line functions is thus to persuade and compel operational departments to implement system change (Cartwright et al., 2012; Taylor, 2016). Alongside this, the political stratum exerts significant pressure to change on operational departments. However, the nature and extent of change proposed by these 'strategic functions' pose considerable risk to operational departments<sup>131</sup>. According to the Utilities Directorate such 'interference' threatens the core business model (function) and financial sustainability of the City. A further statement by the Manager: Technical Strategic Support highlights this:

The Electricity Departments in Joburg and Durban are in the red. They are losing billions every year. We can still pay our bills. And I can tell you why; because we have protected ourselves from interference from politicians and 'strategic' departments. But in Joburg what's happened is the critical mass of competence in the operational departments has gotten so undermined, that service delivery has been destroyed (Interview 6. 03 September 2013).

In response to pressure from politicians and 'strategic units' there is a strong sentiment expressed by officials across the Utilities Directorate that operations 'should be left alone' and 'interference that threatens service delivery and revenue should be avoided' (Head: Green Energy. Interview 11. 04 December 2012). This view is summarised by the Head of Pricing and Regulation:

To facilitate change you don't go to operational departments that are busy with service delivery, who are overloaded and are undertaking core services and say you must do work on renewable energy. All you are going to do, if you continually try to deal with the lack of strategy or additional service delivery demands by pushing it onto operational departments - you're just going to make them angry (Interview 16. 16 September 2013).

These functional differences create considerable organisational tension in the City. Notably, as a result of their function, operational departments tend to have a more cautious and compliance-based organisational culture (De Visser, 2012; Davison et al., 2015). Further, there is widespread conflict between these functional camps in relation to organisational priorities. Across interviews, officials in the Utilities Directorate held that a properly functioning administration, with competency and limited corruption, is more critical in a developing city than pursuing objectives such as climate mitigation.

In brief, in the language of the MLP, it is evident that departments in the Utilities Directorates such as the Electricity Department, actively seeks to protect the integrity of the incumbent municipal infrastructure regime and reproduce its current business model. This is due to the underlying function of these operational departments. Conversely, strategic units such as Environmental Management, based on their functions, actively seek to change and disrupt the status quo. Overall, this functional tension creates contestation in relation to a sustainable energy transition in the City.

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<sup>131</sup> See Section 8.4

However, it is not only function but, as discussed in the following sections, organisational structure that impacts on transitions processes.

### 8.2.2. Organisational structure in the City of Cape Town

It is evident that the organisational structure of the City impacts on the ability of socio-technical regime change in various ways. This section uses the elements of organisational structure developed by Breward et al. (2016) to analyse the City of CT's organisational structure and its relationship to sustainable transitions. These elements include centralisation, formalisation of rules, division of labour (specialisation), departmentalisation and chain of command. Additionally, this section assesses organisational elements such as incentives, budget and financial structures, procurement and supply chain structures and organisational capacity and continuity.

First, the City is highly centralised. The extent of centralisation is evident from the City's Systems of Delegation<sup>132</sup> (CCT, 2007b). An analysis of this document highlights a rigid and hierarchal delegation of authority whereby departments and line functions may only undertake actions that are mandated within this internal policy (CCT, 2007b). It gives directorates, departments, managers and officials only enough authority to make decisions on tightly defined terms. Importantly, it is necessary to assess delegations provided to ERMD and the Electricity Department under the Systems of Delegation (CCT, 2007b) in order to evaluate mandates delegated to these departments in relation to facilitating a sustainable energy transition. ERMD's mandate is highly constrained, with no delegations related to EE, renewable energy, demand-side management or climate mitigation.<sup>133</sup> The delegations provided to ERMD are more aligned to conventional municipal environmental management and pollution control duties. This is corroborated by reports (Taylor, 2016, SACN, 2013; SALGA, 2013c; NT, 2013c; De Visser, 2012) and interviews with officials in the ERMD who widely held that the department has insufficient authority in relation to facilitating change to the City's electricity regime. The delegations provided to the Electricity Department<sup>134</sup> are similarly tightly constrained and entirely focused on grid management and maintenance. It provides no delegations in relation to activities that could result in reconfigurations or even slight adjustments to the incumbent electricity regime.

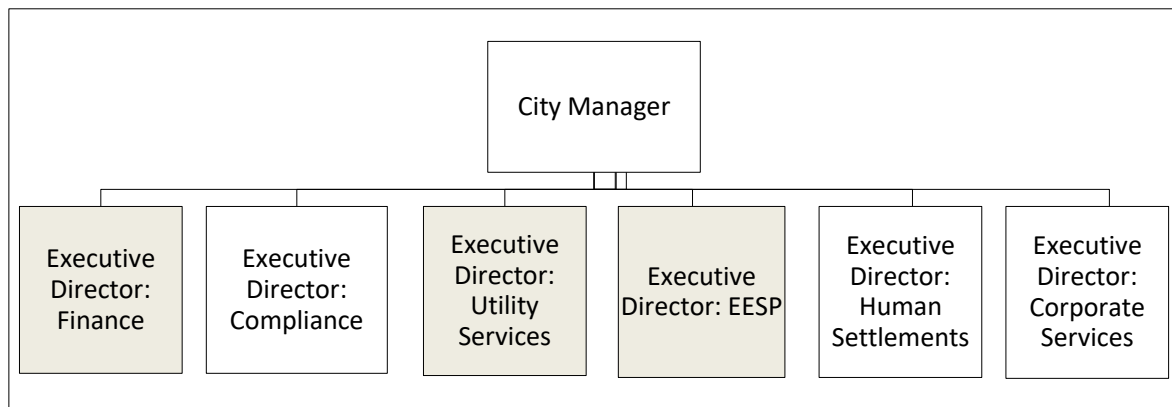
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<sup>132</sup> A policy and organisational framing document that assigns and prescribes delegations and mandates of every line function.

<sup>133</sup> Section 138 - Function Specific Delegations of Director: Environmental Resource Management.

<sup>134</sup> Section 150 - Function Specific Delegations of Director: Electricity Services.

*Figure 8.2: Organogram of City of Cape Town's top management structures*



Source: Organogram developed from information on CCT, SAP Portal/eServices

Second, there is also a strict formalisation of rules in the City. As shown in the preceding chapter, local government is regulated by a host of national rules related to electricity. These are in turn 'ratified' and entrenched in City by-laws, policies, standard operating procedures, guidelines and protocols. Notable formal rules<sup>135</sup> that constrain socio-technical change include the Municipal Systems Act, 2000, Municipal Finance Management Act, 2003, Electricity Supply By-law (CCT, 2004), Tariff Bylaw (CCT, 2007a), Supply Chain Management Policy (CCT, 2008), Budget Management and Oversight Policy, Performance Management Policy Framework (Compliance) (CCT, 2011p), Residential Electricity Reticulation Policy (CCT, 2014c) and the Systems of Delegation (CCT, 2007b).

Third, a rigid division of labour and 'assembly-line' approach to ensure continued and uninterrupted service delivery impacts on the capacity to coordinate widespread socio-technical change. The Head of Green Energy highlights that officials in the Electricity Department are given job descriptions that provide 'only enough authority to ensure the stability and reliability' of the distribution network (Interview 11. 04 December 2012). This strict division of labour is particularly apparent in operational departments involved in network infrastructure.

Four, related to the above, there is inflexible departmentalisation and entrenched silos between (inter) departments and even within (intra) departments (Davison et al., 2015; Cartwright et al., 2012). Conversely, there is a strong organisational rationale for this departmentalisation. In order to ensure effective operation and management of complex networks, management structures and department functions need to be clearly defined and hierarchal. Accordingly, silos do not hinder, but in fact enhance networked service delivery. However, silos are significant obstacles when integrated and coordinated responses to complex challenges are sought. In brief, departmentalisation inhibits the ability of the City to coordinate resources and responses (Smith

<sup>135</sup> See Chapter 7

and Stirling, 2008), a precondition for facilitating change in a complex system such as the City's electricity regime.

Five, there are limited incentives for officials to pursue programmes aimed at socio-technical change. There are no indicators related to innovation in 'sustainable energy' in HR systems such as Key Performance Areas, performance management systems, corporate score-cards or the Mayor's dashboard. The Municipal Energy Efficiency Programme provides a good example of the impact of limited incentives on innovation (SALGA, 2013c). In brief, the City has a centralised electricity billing system and accordingly line departments do not receive the benefits of energy savings in budget and resource allocations. Targets related to energy management do not fall within departmental budgets or key performance areas (CCT, 2011d; SALGA, 2013c; CCT, 2010f). Thus, there are few incentives for departments other than ERMD to engage in EE programmes or to monitor and manage their own electricity consumption (SALGA, 2013c; NT, 2013c).

Notably, the City budgeting and financial structures are a hindrance to energy transition initiatives. Budgeting is done in a bottom-up manner whereby departmental directors request managers to outline expected expenditure on existing projects in the following financial year. According to the Head of Energy and Climate, the focus on existing projects 'restricts the introduction of new and novel projects' (Interview 23. 26 August 2012). Notably, according to the Director of Budgets, EE and renewable energy projects are 'not regarded as priorities in the City budget' (Interview 18. 14 February 2013). The presence of this structural budgeting and financial impediment is highlighted in a report by SALGA that examines 'Regulatory and policy obstacles to the adoption of renewable energy and energy efficiency technologies by municipalities'. In this regard, the report reads:

The upfront capital requirements for renewable energy and energy efficiency projects also need to compete with other demands on municipal capital budgets for priority investments, and typically renewable energy and energy efficiency projects are not seen as priorities (SALGA, 2013c: 8).

The financial and accounting systems in the City also create structural challenges to energy management and efficiency projects in municipal operations. A report requested by the Energy Committee emphasises that

[a]ccounting practices within the City do not recognize the monetary value of savings and the opportunity to do a mass retrofit of the City's infrastructure at no upfront cost could be lost. The City's policies surrounding financing options are also limiting the success of projects under the Action Plan. Many electricity efficiency interventions require upfront capital, which the City may not have at its disposal (CCT, 2010f: 2).

There are moreover significant path dependencies in municipal supply chain management that impede adoption of new EE and renewable energy technologies. According to the Senior



Professional Officer in ERMD 'sustainable energy' is currently not a criterion in the City procurement policy and the supply stores do not stock any EE or renewable energy technologies (Interview 24. 16 August 2013). This reinforces and reproduces incumbent technologies utilised to power City operations.

Further, the City has organisational capacity constraints including limited human resources, technical knowledge and skills related to managing reconfigurations. This problem is magnified by an absence of assistance, technical support and advice, from national government and municipal support agencies, to departments that wish to implement sustainable energy interventions (SALGA, 2013b; NT, 2013c). A report commissioned by the Energy Committee highlights that

[m]any of these projects involve new concepts and technologies, and many of the City's branches and departments are not capacitated with sufficient staff - staff with the skills required to facilitate the effective rollout of projects (CCT, 2010f: 2).

Notably, there are serious capacity constraints in the Electricity Department, with a shortage of staff and the inability to recruit graduates that would be equipped to manage a sustainable transition (CCT, 2011f; CCT, 2010f). This sentiment is expressed by the Head of Green Energy:

To facilitate sustainable energy on a city-scale you need more renewable energy experts and engineers able to drive change. But we cannot seem to recruit young renewable energy engineers in the Electricity Department. Part of the problem is that the values of graduates are so different from the Electricity Department. Young engineers don't want to work here. Now we have a major continuity challenge – and that will stifle innovation (Interview 11. 04 December 2012).

There is also limited skills transfer and knowledge exchange between departments regarding sustainable energy project implementation (SALGA, 2013b; NT, 2013c). Related, the Electricity Department has serious organisational continuity challenges and a fragmented organisational history. Following South Africa's democratic transition, the department had to consolidate into a single entity through an amalgamation of electricity-related functions operating in 39 local authorities and 19 administrations (CCT, 2012b). Later, widespread organisational change took place during the RED1 process where the department was restructured into a de facto independent institution and functionally moved out of the City (CCT, 2010f). Several interviewed officials in the Electricity Department remarked on mistreatment during this process, which led to an out flow of skilled staff (Head: Pricing and Regulation for Electricity. Interview 16. 16 September 2013). The consequence of this organisational discontinuity is highlighted by the Head of Protection and Measurement:

The Electricity Department has modelled itself around surviving in huge uncertainty and institutional battery for 15 years; so it is a silo. It has led to a survivalist mentality,

intolerance against interference and an unwillingness to undertake projects that have inherent institutional risks (Interview 21. 16 September 2013).

This organisational history has produced a 'fierce' resistance to change and interference. The lack of organisational continuity in turn results in both unwillingness and an inability to facilitate or support processes of socio-technical change.

### 8.2.3. Organisational cultures in the City of Cape Town

A range of different organisational cultures operate in the City. This has been highlighted by Froestad et al. (2012) in an analysis of the difference in organisational cultures between departments; ERMD and PBDM. This section examines the organisational cultures of ERMD and the Electricity Department and its impact on reconfiguration processes. Elements of organisational culture, which may have a notable impact on transition processes, include management style, values, knowledge, distance from power and uncertainty avoidance (Breward et al., 2016).

First, the Electricity Department and other operational departments are managed in a technocratic fashion with a strong emphasis on technical expertise. In contrast, ERMD adopts a management style characterised by reflexivity, networking and multi-level engagement, with a strong emphasis on activism (Taylor, 2016; Froestad et al., 2012). These two management styles are situated within and influenced by the overall management style of the City, which is typical of command and control management. This includes centralised power (CCT, 2011e); accountability mainly through formal processes; strict hierarchies and delegations of responsibilities (CCT, 2007b); exclusion of private and not-for-profit sectors and citizens from the domain of service delivery, planning and strategy (SACN, 2013); and use of prescriptive regulation as a means to control behaviour. Further, line functions that play the role of more traditional public administration such as the Finance Directorate tend to have a bureaucratic management style, based on strict hierarchies and clear delineation of functions and responsibilities, with a highly cautious approach to public expenditure and policy decisions. Thus, divergent management styles are present in the City.

Second, it is evident that these two departments hold and prioritise widely different organisational values. The Electricity Department places significant importance on development, equality, redistribution and pro-poor service delivery. Across interviews, Electricity Department officials expressed the need to 'give voice to the concerns of low-income communities' (Head: Green Energy. Interview 11. 04 December 2012). In contrast officials in ERMD expressed strong values related to environmental sustainability such as a moral duty to mitigate climate change and to urgently reduce resource consumption. This profound difference in values between the Electricity Department and ERMD is captured by the Head of Green Energy:

We are not hired to be environmentalists. We are hired to design and operate a well-functioning electricity system. But we have other important passions, like electrification and pro-poor energy services. These people have decided to do civil, public good work as a starting point. But our ideology would be “it is not up to us to push agendas about climate change”, especially because national government is at the forefront of less developed countries. Why should Cape Town do more? (Interview 11. 04 December 2012).

The above statement highlights these contested values related to socio-technical infrastructure, of ensuring efficient and dependable pro-poor networked services (Electricity Department) on the one hand and pursuing the urgent reconfiguration of energy systems (ERMD), on the other. Importantly, these different organisational values create tensions that influence the form and priority of sustainable energy initiatives. As summarised by the Head of Pricing and Regulation:

When a department with an environmental agenda comes and says that we [Electricity Department] are doing a bad job or we are a bad people it just furthers the divide between these departments. We are villainised and misrepresented as being obstructive and malevolent when in fact we are doing our job well - with major obstacles. Hating us just polarises our view. (Interview 16. 16 September 2013).

Third, there is a divergence of knowledge traditions in the City. The Electricity Department is grounded in an engineering, rational, deductive and evidence-based knowledge tradition (CCT, 2010f; Jaglin, 2014). This is because the operation of large reticulation services depends on sound engineering practices, systems and processes and associated knowledge forms. Thus, technical and specialist knowledge and skills are prioritised. In contrast, officials in ERMD come from diverse disciplinary backgrounds stemming from the knotty nature of environmental challenges. Accordingly, officials in ERMD place less emphasis on technical knowledge and attach greater importance to holistic and inter-disciplinary knowledge forms and approaches to challenges. This is however viewed by operational departments as lacking in rigour and impacts on the willingness of these departments to take on novel projects. As highlighted by the Head of Green Energy:

If ERMD wants us to implement a ‘green energy project’ it must be designed effectively - it must be straightforward and technically sound. It can’t threaten core electricity services. If it is a service intervention, it must be cost reflective, rational and fulfil socio-economic objectives. You need a proper, thoroughly thought through approach when dealing with large services. Utilities are run like a business. We need to keep the lights on (Interview 11. 04 December 2012).

Four, the distance to power of different departments has a strong bearing on respective institutional cultures and correspondingly reconfiguration processes. This is further discussed below<sup>136</sup>. Nevertheless, it is worth mentioning that the Electricity Department, due to its function of service delivery, contribution to revenue (CCT, 2012b) and formally regulated powers, is closer

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<sup>136</sup> See Section 8.2.5

to the City's policy elites or decision-makers. On the other hand, ERMD is far removed from key decision-makers and hence employ a range of mechanisms to influence decision-makers.

Five, the Electricity Department tends towards uncertainty avoidance. Due to the technical precision required to deliver a network service the Electricity Department tends to be wary of 'innovation' (Cartwright et al., 2013; De Visser, 2012). This cautious management approach is demonstrated by the Head of Green Energy:

Local government can undertake interventions outside areas of strict competence, but this requires managing it as an exception. Typically, officials work to "comply" and battle to do even this in South Africa (Interview 11. 04 December 2012).

In contrast, a primary objective of ERMD is to radically and urgently reconfigure the City's electricity and infrastructure systems to more sustainable domains. This is evident from the urgent framing and tight timeframes envisaged by the Energy Visions 2030 (CCT, 2015b); ECAP (CCT, 2010a) and the Optimum Energy Future (CCT, 2011a). Thus, uncertainty avoidance and caution is in direct opposition to their goals. This is conveyed by the Head of Energy and Climate Change:

We need to act quickly and decisively on lowering our electricity consumption and emissions. Cape Town and the country are high carbon and energy intensive. We have a responsibility to mitigate; and soon. If we do not change the international community will not invest in our country. We will continue to have electricity shortages and electricity prices will skyrocket (Interview 23. 26 August 2012).

The above statement highlights that for ERMD, the potential outcomes of inaction, including climate change, electricity supply constraints and energy insecurity, outweigh the risks that may be associated with changing 'ways of doing' service delivery. Overall, uncertainty avoidance is highly coupled with risk and the interpretation and internalisation of risk by different organisational functions in the City. The next section examines risk further.

#### 8.2.4. Organisational risk and innovation

The City in general and the Utilities Directorate (operational) and Finance Directorate in particular confront significant risk associated with implementation of 'sustainable' energy initiatives and reconfiguration processes. This section examines and classifies the types and nature of risk the City in general and operational and financial functions in particular confront in relation to and its impact on energy transitions.

First, sustainable energy initiatives impose risks on the day-to-day service delivery functions and procedures of departments. A relevant example of the extent of such risk is highlighted by a proposed policy developed and lobbied by ERMD, called the Resource Efficient Development Policy, which intended to prescribe mandatory efficiency criteria for all new developments (CCT, 2016).

According to officials in PBDM, such a policy, if too rigid, could have considerable impacts on entire building management systems. According to the Head of Land-use Management:

The City processes approximately 30 000 new building applications a year. If there are any concerns regarding the fitness of an application, it is referred to a political committee. There are severe risks that mandatory efficiency criteria can result in the bulk of building applications being subjected to lengthier and more complex assessment processes, which could obstruct the entire building approval system (Interview 4. 31 October 2013).

This is corroborated by the result of a survey on the risk associated with implementation of SANS 10400-XA (SANS, 2011a) and SANS 204 (SANS, 2011b), which requires municipalities to enforce mandatory EE criteria for all new buildings and extensions. The results of the survey highlight that building management officials<sup>137</sup> have confronted significant delays and challenges in the planning approval process related to enforcement of these regulations. PBDM officials held that applications seldom comply with the criteria in submissions, the building industry lacks capacity to ensure compliance and the department receives constant complaints from developers (Roux and Kamish, 2013). In brief, regulations create risks that place PBDM and the City's building management system in near paralysis.

Second, as discussed in previous chapters the City confronts significant risks related to revenue loss arising from energy transition initiatives. This is particularly felt by the Finance Directorate and Utilities Directorate. The risk of revenue impact has had widespread consequences for proposed sustainable transition initiatives including a backlash and resistance to ECAP projects (Laurent and Trollip, 2013). Across interviews officials in ERMD held that budget allocation and political support for flagship energy transition projects such as the Mass Solar Water Heater Programme are refused due to potential revenue loss that could transpire. The way in which the Electricity Department experiences and responds to this risk is expressed by the Head of Pricing and Regulation:

The Electricity Department and the City's core business is selling electricity not promoting electricity saving. Why are we running a campaign that threatens the City's financial sustainability and why are we spending money on such a campaign? (Interview 16. 16 September 2013).

Related to revenue loss, departments also resist transition initiatives that diminish its capacity to cross-subsidise the poor and provide free basic services (CCT, 2011j; CCT, 2012c; CCT, 2012h; CCT, 2012d; CCT, 2013b). Thus, projects are resisted that threaten the organisational values of different departments.

Third, officials run risks associated with rolling-out initiatives that are regarded as politically indefensible in the city's socio-economic context. During participation in meetings and workshops

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<sup>137</sup> City plan examiners, building control officers and building inspectors.

various projects under the ECAP (CCT, 2010a) including a Mass Solar Water Heater Programme, net-metering and large-scale renewable electricity, all of which target middle and high income households, were labelled as politically indefensible by officials and politicians (Energy and Climate Change Committee Workshop, 09 November 2012). According to the Principal Engineer: Energy and Climate, 'if there is political fallout or an inappropriate project is rolled-out officials are in deep trouble' (Interview 20. 23 August 2013). Thus, officials are wary of driving transition projects that are potentially open to political criticism and are confronted with professional risks related to project failure (Greyling *et. al.*, 2016; Taylor, 2016).

Four, officials confront significant legal risks related to non-compliance with regulatory instruments (Collier and Glazewski, 2012; De Visser, 2012; Cartwright *et al.*, 2012). Notably, officials in the Finance Directorate face risk related to financial mismanagement including personal and criminal liability. The experience of these risks is highlighted by the Director: Supply Chain Management:

In Supply Chain, if you make a mistake in our political and legal dispensation you could end up in jail. You could lose your job. So for us, in the very best of faith - to do our jobs properly, we have to be cautious. In the City there have been a couple of appeals against tender awards. These malicious investigations, usually politically motivated, really create fear. Because of this we are wary to taking on "different projects" (Interview 17. 14 September 2013).

City officials also contend with risks related to consumer dissatisfaction and customer complaints if service delivery, such as stable electricity supply, is impacted by a transition project or programme (CCT, 2011k). For example, the fear of public backlash has been a predominant factor in the decision by the Electricity Department to discontinue the use of its ripple control system (Head: Protection and Measurement. Interview 21. 16 September 2013).

In summary, operational departments tend to avoid or resist energy transition projects, programmes or policies that may disrupt service delivery, impact on revenue and associated capacity to cross-subsidise, is politically indefensible, may result in consumer dissatisfaction or exposes themselves or the City to professional, legal or personal risk. It is next necessary to further examine the impact these risks have on sustainable transitions.

According to De Visser (2012) organisational risks in the City produce a compliance-culture, based on caution and risk assessment. The manner in which officials weigh up and assess risk in relation to innovation is outlined by the Director: Supply Chain Management:

There's the percentage chance of something going wrong. Then there's the consequence. So in terms of risk assessment, you will take the conservative approach. Here's the choice. Help with a project that is tricky, that's never been done before. We take the risk, a Councillor makes an allegation, the forensic lawyers walk in and instead of doing procurement they will be going through your computer, going through all your emails. It's

an absolute no brainer. It's not a matter of untoward caution. It's a matter of professionalism (Interview 17. 14 February 2013).

Thus, risks impact on the willingness of departments to engage in transitions and enhance a compliance-culture that stifles innovation. During interviews officials in ERMD repeatedly raised that sustainable energy initiatives are hampered by this risk-aversion. According to the Principal Engineer: Energy and Climate:

As soon as an "innovator" starts at the City they are bogged down by process, bureaucracy and red tape. Throughout the process you are criticised, chastised and shouted at. If you succeed the politicians take credit. The innovation space is a dangerous place to be for a local government official. There are no incentives to be innovative. The greatest motivation for officials is to not get into trouble. (Interview 20. 23 August 2013).

Greyling et al. (2016) illustrate that the impact of risk on hindering sustainable innovation is deeply structural in the City. Apart from structural impediments; several interviewed officials in ERMD assert that the administration actively weeds out innovative projects and officials (Interview 23. 26 August 2012). Conversely, challenges at the intersection of infrastructure, urbanisation, electricity and climate mitigation are 'wicked' in nature and thus require innovative and interdisciplinary responses (Hodson and Marvin, 2010). Managing socio-technical change thus requires 'protective spaces' in public agencies to facilitate innovative responses (Smith et al., 2010). However, many officials interviewed in ERMD highlight the absence of such space in the City of CT. According to the Principal Engineer: Energy and Climate:

Innovation is very difficult in local government. We need innovative teams in certain places and the institutional space to not be bogged down by rules and risks. When you actually look at the culture in the City, I see a top-down approach; there is risk aversion by individuals, that the culture is intolerant of mistakes. And without admitting that a mistake is made you can't learn from a mistake or deal with a problem (Interview 20. 23 August 2013).

Rather, it is evident that the City responds to such complexity by using tried and tested tools used for dealing with 'business-as-usual' or conventional service delivery challenges. The problems with this approach are described by the Head of Energy and Climate Change:

When new and complex threats occur, the immediate management response in the City is "more of the same". Officials retreat to the same policy tools that they use for their usual, run of the mill problems. So, with the recent black-outs, officials in Utilities opt for a supply-driven response - increase supply rather than focus on tackling the underlying, systemic problems (Interview 23. 26 August 2012).

This sentiment is echoed by a Policy Researcher in the Strategic Policy Unit:

Compliance and risk aversion is no longer functional for an organisation in a rapidly changing environment. It is inevitable that without experimentation local government won't have the capability to respond appropriately to change. The change and risks

related to energy and climate change are so rapid that we cannot only do service delivery anymore. There is a point when risk aversion becomes risky (Interview 2. 05 June 2013).

In summary, operating large networks requires constant and uninterrupted service delivery. The reconfiguration of network infrastructure and services create a host of risks. These risks create a compliance culture that stifles innovation and prohibits experimentation. Thus, the type of innovation and experimentation required for rapid sustainable transitions are the antithesis to the City's role in network service delivery.

#### 8.2.5. Transition politics and power in the City of Cape Town

This section examines the process of transition policy development, transition power struggles and transitions politics in the City of CT. There are complex power dynamics and power struggles in relation to socio-technical transitions in the City, particularly in respect of unequal powers of negotiation. The Utilities Directorate (Electricity Department) has significant power of negotiation and policy influence in relation to the reproduction or reconfiguration of network infrastructure. This power stems from regulated mandates, the contribution of network services to revenue and political support stemming from the public goods they provide. Conversely, strategic planning departments have limited power of negotiation or influence. Notably, ERMD sits far outside (Smith and Stirling, 2010) the City of CT's core decision-making nexus. Thus, it actively attempts to influence regime members and key decision-makers (Head: Energy and Climate Change. Interview 23. 26 August 2012). The success or failure of sustainable transition initiatives is thus dependent on the extent to which these strategic planning departments can influence operational departments. Attempts by ERMD to coax, co-opt and persuade decision-makers were observed on multiple occasions. This takes a number of forms ranging from hostile to cooperative.

Methods used by ERMD to counteract this unequal balance of power include co-opting international networks to apply pressure on urban policy elites; establishing institutional structures as a means of forcing action (CCT, 2010a); using umbrella organisations to strengthen and elevate policy positions; making decision-makers 'aware of potential risks of business-as-usual' (Head: Energy and Climate Change, Interview 23. 26 August 2012) and creating platforms, networks and partnerships with external partners. Softer methods, such as offering resources including funding and technical support (Meeting with City of Munich, 24 March 2014) are also utilised. An element of this soft power, used by ERMD, is to morally critique the City's incumbent electricity regime in order to erode support, conviction and confidence in the regime. The grounds of critique include criticism of the revenue and business model (Trollip *et al.*, 2013; Laurent and Trollip, 2013), energy and emissions intensity (SEA, 2015b; CCT, 2015a) and limited labour absorption potential (McDaid, 2013) of the incumbent regime. These include on-going attempts to bring climate change, energy



insecurity and benefits of low-carbon development to the attention of executive directors, directors and politicians (CCT, 2015a; CCT, 2012f). Alongside these critiques the Energy and Climate Change Unit and broader urban climate network offer alternatives to the 'incumbent' structure of the City's electricity regime, through for instance developing alternative visions, such as the Cape Town Energy2040 vision (CCT2015b) or scenario planning (CCT, 2011a). The Optimum Energy Future (OEF) study for example, commissioned by the Energy and Climate Change Unit and undertaken by Sustainable Energy Africa and the Energy Research Centre, provided an 'alternative, low carbon, affordable and efficient scenario' for Cape Town's energy future and proposed steps for achieving such a future (CCT, 2011a; SEA, 2015a). The OEF was a form of pathway identification that outlines multiple potential energy futures and identifies actions needed to realise an 'optimum energy future'. In brief, it was aimed at both critiquing the status quo and simultaneously outlining alternative pathways and options in facilitating transformation processes. The Principal Engineer in the Energy and Climate Change Unit highlights that tools, research and plans developed from outsiders are often absorbed by 'internal policy receivers in the City that are receptive to these signals' (Interview 20. 23 August 2013). Thus, hard-line pressure alongside collaboration is an important tool employed for influencing change. In the language of the MLP, this is intended to both create and influence pressures to act and influence the way that these pressures are articulated and responded to by decision-makers (Smith and Stirling, 2008). In other words, this is an attempt to force 'core' regime members to articulate and act on selection pressures. In brief, the strategies and modes of governance adopted by strategic planning units (and the broader urban climate network) are largely grounded in levelling the playing field in relation to unequal power relationships vis-à-vis incumbent organisational power and regimes.

It is evident that the City's transition policy related to infrastructure regimes are contested and made through numerous formal and informal forums. Predominantly, policy contestation occurs in Portfolio Committees (political forums) such as the Utilities Portfolio Committee and the Economic, Environmental and Spatial Planning Portfolio Committee. Specifically, the Energy Committee is a major site for policy contestation related to the reconfiguration of the City's electricity regime. Notably, a three-way policy tension between the political stratum (Councillors), traditional administrative sphere (Utilities and Finance Directorates) and City functions that drive change (such as ERMD) are contested, mediated and negotiated in these platforms.

Further, differences in policy direction are deliberated on and pushed through various administrative structures and processes. This includes contestation for 'inclusion of projects in Five-Year Integrated Development Plans' and lobbying for increased authority under annual amendments to the Systems of Delegation (Interview 23. 26 August 2012). Importantly, policy

contestation is prevalent in budget allocations in annual and five-year (MTREF) budgeting cycles (Taylor, 2016; Collier and Glazewski, 2012). The Budget Steering Committee and the MTREF process thus play an important role in negotiating and defining transition policy (De Lille and Kesson, 2017).

Notably, policy-decisions are often made in informal meetings and discussions. This was observed in several informal meetings during fieldwork. In a meeting between PBDM and ERMD, for instance, the Head of Building Development Management, using discretionary power, decided that a lenient planning approval process would be adopted for solar PV and solar water heaters (Meeting 36. CCT Planning and Building Development Management, 24 October 2012). On two occasions the Head of Budgets gave substantial budget allocation to ERMD for future 'sustainable energy projects' during informal meetings (Meeting 25. CCT Finance Directorate, 07 September 2012).

Two pertinent points may be extracted from the above. First, it is evident that City transition policy is often developed in a bottom-up manner whereby middle management tends to drive a particular policy agenda 'upwards' through the various chains of command until it is adopted by the executive management. This process of 'muddling through' is well documented in the City of CT (Froestad et al., 2012). Second, City transition policy is heavily influenced by the personality and powers of persuasion of particular individuals in the administration.

There are several mechanisms for mediation and negotiation in these policy contestations. Policy negotiation and compromise often occur during policy formulation processes such as transversal workshops, Executive Management Team meetings and commenting on draft policies. Moreover, during public participation processes, undertaken by the Public Participation Unit, the City of CT negotiates policy with communities and Cape Town citizens. The Strategic Policy Unit, (SPU) established in 2013 as an institutional structure to coordinate overall City policy (CCT, 2014a) attempts to mediate policy positions between the political stratum and officials, which occur throughout policy formulation processes (Meeting 50. CCT Strategic Policy Unit, 29 January 2013). The SPU has attempted to set up a range of systems to negotiate policy differences across the City of CT (De Lille and Kesson, 2017; CCT, 2014a). For example, it has pursued the restructuring and alignment of working groups, sub-committees and task teams (CCT, 2014a; CCT, 2015c). Further, it has sought reform in the policy development process aimed to achieve integrated decision-making. These include discussing policy direction in Executive Management Team meetings and work groups; the mandatory coordination of 'transversal workshops' during policy development; mandatory distribution of policy drafts to all parties potentially affected; stipulations for proper public participation and properly briefing Mayoral Committee and Council prior to policy adoption (CCT, 2015a).

In summary, policy and decision-making related to energy transitions is undertaken in multiple forums, are made with a range of motivations and based on varying degrees of knowledge and information (Greyling *et al.*, 2013) at hand and available in terms of robustness.

Politics and political conditions, both between national government and the City and within the City administration, play an important role in the City's socio-technical reconfiguration process, particularly in terms of framing transitions. The main inter-relationship between regime reconfigurations and politics identified relate to opposition politics, political change and electoral cycles, political interference and conflicting priorities between politicians and technocrats. Each of these requires further elaboration.

First, the City is an opposition government-led municipality in South Africa. According to the Head of Energy and Climate Change this results in less national grants, greater scrutiny of projects and officials and less influence in national energy policy (Interview 23. 26 August 2012). As a result of greater scrutiny, City officials have to be more compliant, particularly in relation to municipal audits, legal compliance, monitoring and evaluation and financial management (Davison *et al.*, 2015; Greyling *et al.*, 2016). According to the Director: Budgets, 'the City has to have a squeaky clean audit which exacerbates a "risk adverse" culture of the Finance Directorate' (Interview 18. 14 February 2013).

Notably, it is evident that the scrutiny by national government is used as a justification by departments and officials to oppose support for innovative sustainable energy project. According to the Principal Engineer: Energy and Climate:

If other municipalities do efficiency interventions, the Electricity Department can still say that the City prides itself in obeying the law. And because of the fact that we are an opposition government, NERSA may ask the City to be compliant and turn a blind eye on other municipalities. This space is governed by politics more than it is governed by the rule of law (Interview 20. 2013).

Further, officials in both the Electricity Department and ERMD hold that the Department of Energy provides less national capital transfers to Cape Town for Integrated National Electrification Programme Grants, Equitable Share Grants and EEDSM Grants. This is summarised by the Head of Energy and Climate Change:

The Department of Energy would much rather give funding to smaller ANC-led municipalities. Even DOE officials that work with the City and trust our record are under political pressure to limit our funding. EEDSM funding allocations are usually first given to other ANC-led cities and then Cape Town mops up the remainder ...The truth is that it is merely politics. National government is obliged to give a DA-led government a hard time (Interview 23. 26 August 2012).

This is corroborated by reports that show that for the national low-pressure solar water heater programme Cape Town was allocated 100 000 systems (SEA, 2013a). This is far less than allocations to other metropolitan municipalities. Joburg City Power for instance was allocated R60 million for the roll-out.

Second, political changes impact on the continuity of long-term projects (Pieterse, 2008; Cartwright et al., 2012); policy related to reconfigurations (Jaglin, 2013) and the willingness of City of CT departments to pursue innovative projects. Similarly, relatively short-term, five-year electoral cycles also hinder sustainable energy programmes, which require long-term, coordinated action. This temporal mismatch is summarised by the Director: Spatial Planning and Urban Design:

I have had to refine my arguments every 5 years, according to electoral cycles. Some of my programmes have been completely dismantled after elections (Interview 17. 26 June 2013).

Further, in respect of Council politics, officials submit that politicians often interfere with service delivery departments and attempt to insert projects within the administration that can potentially earn political points. This is summed up by the Head of Pricing and Regulation:

Council is often a severe obstacle to service delivery. Politicians interfere with operations and demand “political” projects which are heavily disruptive. They don’t understand the technical nature of operations. If they successfully interfere with them - this can end up in tears. Can you imagine Joburg, the biggest and richest city in South Africa - their utility can’t cover its costs. And the problem is that [people in the] City, are using these other cities as examples of where there is success in doing “innovative” projects (Interview 16. 16 September 2013).

Related to the above, there are conflicting priorities between Council politicians that are accountable to the electorate and seek to gain ‘political points’ and the priorities of technocrats engaged in transition processes (Cartwright et al., 2012; Taylor, 2016; Greyling et al., 2016). According to the Chair: Energy and Climate Change Committee, ‘political preference and priority is regularly given to projects and programmes which promote energy security, local economic development, energy access and affordability, electrification and energy poverty alleviation’ (Interview 12. 15 May 2013). Likewise, the Executive Management Team, in an attempt to mediate between Council and officials, often restrict the nature and focus of energy projects and programmes to ensure that it is suited to the Cape Town’s political climate (De Lille and Kesson, 2017; NT, 2013c) In summary, politics within the City and amongst different spheres of government impact on the nature and form of ‘sustainable energy’ policy and transitions.

## 8.3. Discussion

### 8.3.1. Organisational functions and transitions

This and preceding chapters have shown that the state may have considerable agency, or capacity and capability (Smith and Stirling, 2008) to either influence the reproduction of regimes or govern or leverage socio-technical change. This organisational agency in the City of CT is constituted from a number of factors including regulatory assigned mandates, the presence of champions and organisational structures that either inhibit or facilitate change. This type of organisational capacity has been referred to in recent literature as a fulcrum institution (Honig et al., 2013). It is possible to reconcile the notion of fulcrum institutions with sustainable transition theory in general and the notion of socio-technical regime in particular, as a concept to identify and explore the ways in which organisations may leverage socio-technical regime change. These organisations may be referred to as ‘key regime organisations’. In the language of sustainable transition theory, a key regime organisation may be defined as an organisation that is centrally involved with the operation and maintenance of a regime, but nonetheless has significant power to leverage socio-technical change, disrupt regimes, incubate niches, steer transitions and frame transition agendas. Conversely, it is evident that the City is not able to unilaterally direct regime change in a top-down manner. In this way, key regime organisations are not ‘entirely in control’ (Rotmans et al., 2001) of socio-technical transitions and thus cannot be regarded as a core regime member (Smith and Stirling, 2008). Nevertheless, this complements the conception of core regime membership (Smith and Stirling, 2008). Whereas core regime members serve to protect and reproduce the functions and structure of regimes, key regime organisations have a more nuanced role (and agency) in relation to a regime. Geels (2002: 1257) emphasises that technology can only serve specific functions in association with ‘human agency, social structures and organisations’. Preceding chapters demonstrated that socio-technical regimes are underpinned by specific functions that are codified in and enforced by regulations. This chapter subsequently highlights the relationship between regimes and organisations in respect of functions. In brief, the City’s case indicates that the organisational function of ‘key regime organisations’ often serve to reproduce incumbent socio-technical regimes. Thus, it is evident that the reproduction and maintenance of socio-technical regimes are integrally coupled with both the organisational function and the corresponding organisational survival of ‘key regime organisations’. Correspondingly, the functional requirements (Hughes, 1987) or ‘reason for being’ of key regime organisations creates significant resistance to socio-technical change. Further, it is evident that the decision-making nexus or bounded rationality of key regime organisations are intertwined with wider regime logics. This expands the notion of organisational DNA (Nelson and

Winter, 1982; Geels, 2004) to the broader socio-technical system. This leads to a nested conceptualisation of regimes whereby the deep structure and function of regimes, which may be termed the 'regime DNA' is in turn filtered and embedded in organisations that support its reproduction.

According to Geels (2004) different social groups are formed through differentiation and specialisation processes. This chapter highlighted considerable heterogeneity of functions within the City of CT that are intertwined with wider regime functions. It is thus evident that the process of differentiation and specialisation between social groups is highly defined, bounded and reproduced according to organisational functions, which are in turn embodiments of wider socio-technical regime functions. Notably it was shown that the historical organisational function of the City, as a key regime organisation, serves to reproduce the modes of thought and underlying logics of the organisation and the corresponding incumbent socio-technical configuration. On the other hand, there is a more recent emergence of additional organisational functions that attempt to actively facilitate regime change. Thus, it is evident that different social groupings within key regime organisation may play 'roles' in either actively inhibiting or driving socio-technical transitions, depending on their organisational function.

Subsequently, it is evident that divergent functions lead to 'functional conflicts'. These conflicts are underpinned by power dynamics, allocation of risk and organisational values and priorities. In relation to organisational values and priorities, it is apparent that different functions (social groupings) contest larger socio-technical regime values. In the City's case it is clear that operational departments serve to protect the functions of the regime and the regime values these functions facilitate, namely developmental values such as poverty alleviation, redistribution and the maintenance of continued effective service delivery. Thus, it can be said that these regime values are structurally embedded within these line functions. Attitudes of support or antagonism towards socio-technical change or stability are thus considerably defined by the historical function of a social grouping. This has a significant bearing on whether they utilise their ability to leverage system change or resist change. Overall, these functional conflicts create contestation in framing transitions and, as a result, inertia and lack of coordination in reconfiguration processes. These functions and functional conflicts within key regime organisations thus mirror and impact on broader socio-technical system stability and change.

### 8.3.2. Organisational structure and regime change

The findings of this chapter indicate that organisational structures within organisations centrally involved in the operation and reproduction of socio-technical regimes have a significant bearing on the potential, scope, framing and success (or lack thereof) of sustainable socio-technical transitions. Importantly, organisational departments and actors that drive change nevertheless act within existing organisational structures even when they engage in attempts at restructuring the organisational and wider socio-technical system. Organisational structures that had a bearing on transition processes present in the City of CT included centralisation, formalisation of rules, division of labour (specialisation), departmentalisation, chain of command, incentives, budget and financial structures, procurement and supply chain structures and organisational capacity and continuity. Each of these requires elaboration.

First, the degree of centralisation of power may either enable or constrain transition actions. It is evident that authority is highly centralised in service delivery organisations. Such centralisation plays a dual role. On the one hand, change is highly dependent on the values, decision-making nexus and interests of decision-makers with power. In the City of CT's case, it was evident that change agents operated on the fringe of policy elites and struggled to influence socio-technical change partly because the values and decision-making nexus of policy elites were closer aligned with the incumbent socio-technical configuration. On the other hand, such centralisation of power means that strategies for facilitating socio-technical change require influencing a concentrated few policy elites that could leverage significant change. Such a strategy was evident in the City, where change agents targeted and engaged key decision-makers in attempts to compromise, inspire, barter or coerce them to implement specific socio-technical change within their control. Related, this chapter highlights that a rigid chain of command and hierarchal decision-making impact on sustainable transitions whereas bureaucratic administrative structures delay the implementation of transition initiatives.

Entrenched silos and divisions were present in the City both inter and intra departments. It is evident that rigid departmentalisation within organisations constrain transition processes. This is partly because managing socio-technical change depends on the ability to coordinate resources (Smith and Stirling, 2008) and responses. Thus, in the language of the MLP, organisational silos restrain and prevent coordinated and systematic responses to selection pressures or implementation of transition initiatives even when planned transition action is formally agreed upon in policy. This, moreover, indicates the inverse, namely departmental integration and coordination provides fertile ground for transition processes.

Further, it has been demonstrated that supply chain and procurement systems have dual impacts on the potential for socio-technical reconfigurations. First, supply chain and procurement systems reproduce an incumbent technological pattern or system within an organisation. Second, this reinforces the wider social-technical configuration by supporting incumbent technologies and restricting support and assistance to alternative niche technologies through procurement. Systems of supply thus contribute to socio-technical lock-in and may inversely be used to influence regime change. Related, it is evident that budgeting and financial structures reinforce incumbent regimes. The nature of this regime reinforcement is not deliberate but structural in nature; in that organisational financial and budgeting processes and procedures co-developed and are thus aligned to the status quo.

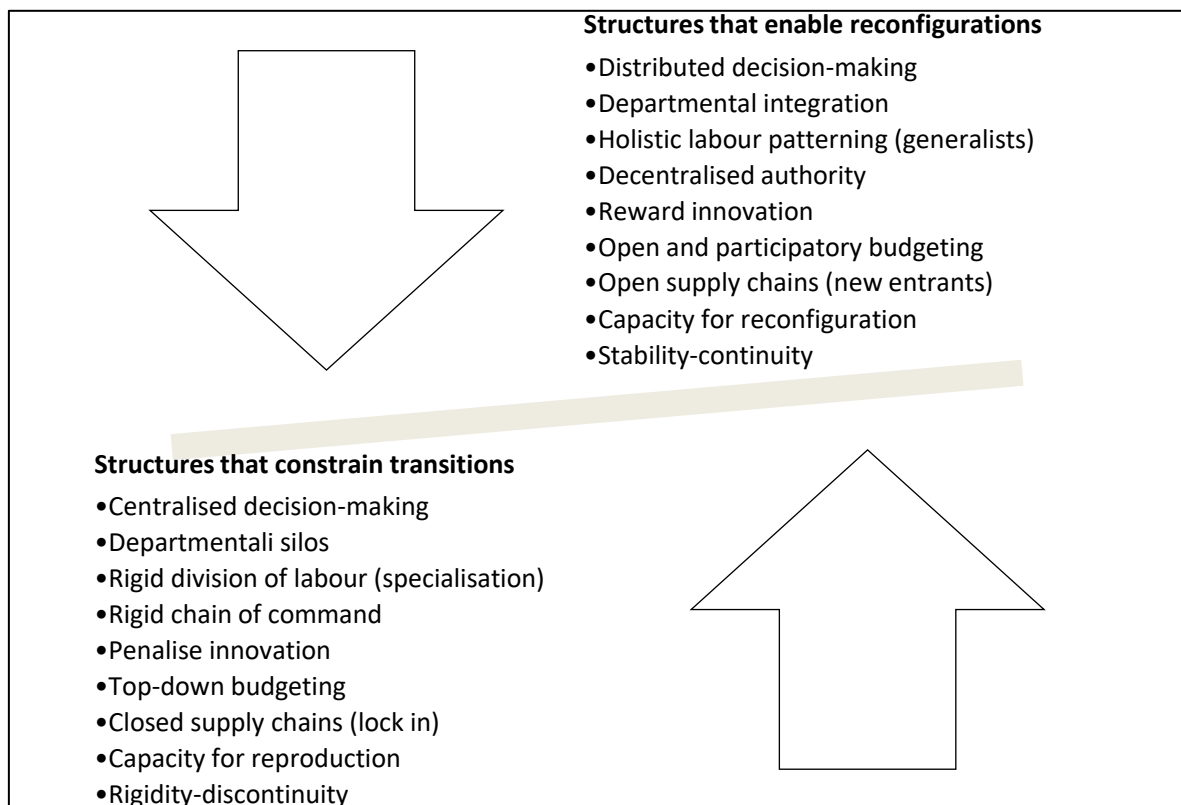
This chapter indicates that the reconfiguration of socio-technical systems is dependent on organisational capacity, particularly the availability of people skilled and trained in alternative or niche technology management, maintenance and operation. In service delivery organisations it is apparent that operational staff have skills, capacity and training predominantly aligned to incumbent socio-technical regimes. In the City of CT's case, there was moreover very limited turn-over and recruitment of employees with skills sets that could facilitate a transition to a different configuration or manage a novel socio-technical regime. Thus, it is evident that transitions are constrained in organisations with limited innovation capacity or capacities solely aligned to an incumbent socio-technical regime.

Finally, it is evident that organisational continuity impacts on transition processes in counter-intuitive ways. It would be expected that a patchy organisational history may make organisations more adaptive and open to change. On the contrary, this chapter highlighted the reverse, i.e. organisational discontinuity creates rigidity and resistance to change. Conversely, organisational stability may provide more fertile ground for adaptiveness and flexibility to socio-technical change.

In brief, organisational structures both constrain action and provide the stability and coordination necessary to enable action. The above organisational structures form the basis for a conceptual model of understanding the organisational conditions that constrain or enable change. This is represented in Figure 8.3.



Figure 8.3: Organisational conditions that enable or constrain transitions



### 8.3.3. Organisational culture and transitions

This chapter has shown that organisational cultures and divergence in organisational cultures impact on sustainable transitions in a number of ways. As shown<sup>138</sup> several aspects of organisational culture, including values; management style; knowledge; distance from power; and uncertainty avoidance impact on the typology and nature of sustainable transitions. Each of these requires discussion in relation to their relevance to transition theories.

First, the findings of this chapter further highlight that different organisations or line functions uphold, embody and defend wider socio-technical regime values. Thus, regime values are central to the identity or act as an organising principle of divergent organisational cultures. In the City of CT it was found that environmental and developmental regime values are in competition with each other between various line functions. This competition is enhanced by limited resources and the somewhat mutually exclusive nature of divergent transition policy agendas. This process of value competition shapes transition agendas and actions in several ways. Competing regime values, embedded in divergent organisational cultures, may result in organisational actors intentionally or inadvertently disrupting or restricting a competing transition initiative. In certain limited

<sup>138</sup> See Section 8.2.3

circumstances, competing regime values may become aligned with or integrated within a transition initiative or agenda. However, it is evident that this regime value competition acts as a selection environment, the outcomes of which are not dictated by 'rational choice' (Geels, 2004) but rather organisational power struggles<sup>139</sup>.

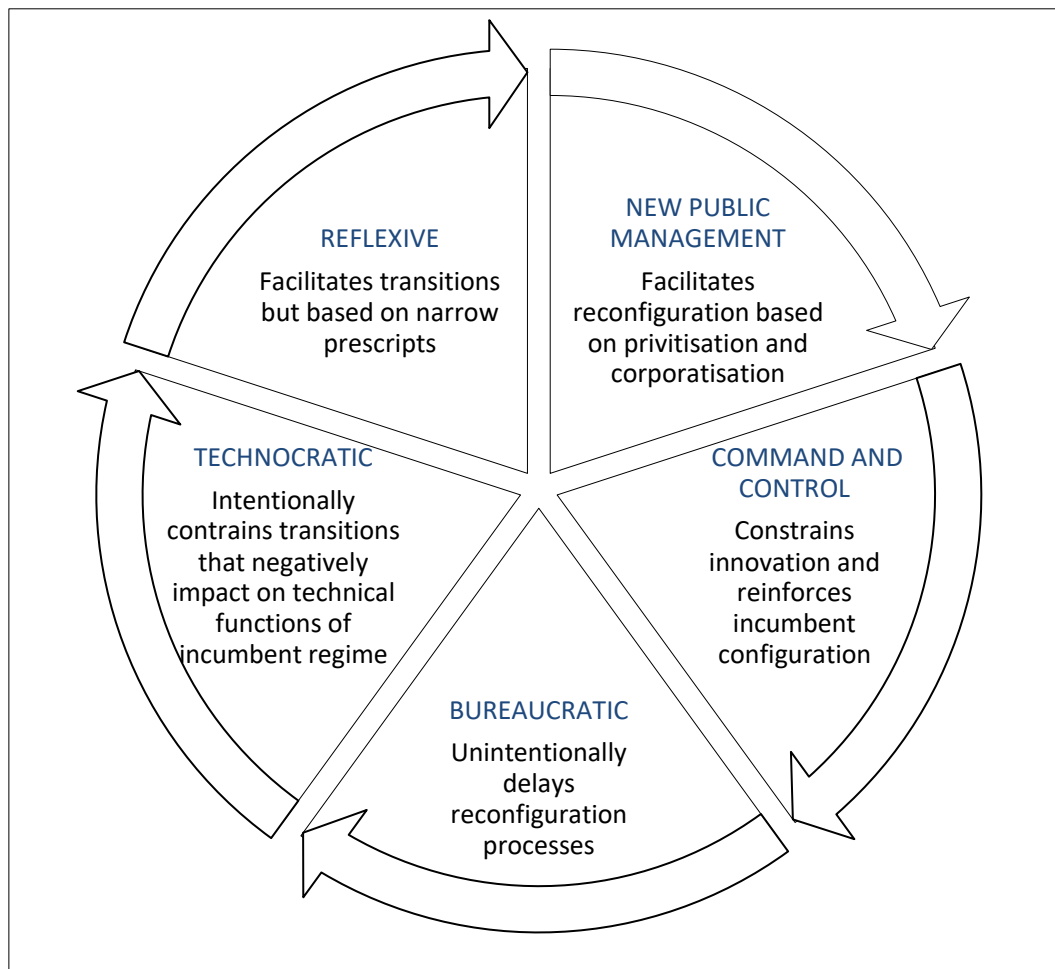
Second, different forms of knowledge amongst different departments have notable relationships with socio-technical systems and change. Whereas the technical, rationalistic and engineering knowledge of operational departments serve to reproduce regime structures and the status quo, the interdisciplinary knowledge evident in strategic departments are closely aligned to or suited to overseeing reconfiguration processes.

Third, literature on transition management suggests that transition management occurs in a vacuum (Hendriks, 2009). On the contrary, it is evident that transition management collides with a hodgepodge of diverse management and governance modalities related to socio-technical regimes. This chapter finds that multiple management styles operated in the City depending on the respective organisational functions of departments. These different management styles interact with each other in complex and interconnected ways in socio-technical transition processes. The management style of the City's executive management closely resembles new public management with an emphasis on efficiency, corporatisation, cost-effectiveness and stream lining of decisions and service delivery. The socio-technical configuration sought by such management includes a limited role of the state in public network infrastructure and corresponding privatisation of electricity infrastructure; a focus on corporate efficiency, cost recovery for service delivery and hence infrastructure consumerisms. The Electricity Department typified by a technocratic management style constrains or obstructs radical environmental transition initiatives. Implementation of transition initiatives and processes are, moreover, often unintentionally delayed by the bureaucratic management style of municipal administrative systems. Overall, a command and control management style is present in the City of CT. It is well documented that such management is the antithesis of the innovation-gearred management required for socio-technical transitions (Walker and Salt, 2012). Finally, strategic planning units adopt management styles more closely aligned to polycentric, network, adaptive or reflexive modalities. A model may be inferred from the above on the impact of different management styles on socio-technical transitions.

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<sup>139</sup> See Section 8.2.5

Figure 8.4: Relationship between management styles and transitions



#### 8.3.4. Organisational risk - innovation and transitions

In this chapter it has been demonstrated that socio-technical regimes and the organisations centrally involved in and vested in their maintenance, operation and reproduction confront significant risk and threats associated with socio-technical reconfigurations. The type of risks identified and associated nature of these risks to the socio-technical regime are outlined in Table 8.1.

It is evident that these risks act as reverse selection pressures, placing pressure on actors to reproduce the incumbent socio-technical regime. Such pressures may be referred to as 'regime reinforcing pressures'. This notion is the inverse of the concept of landscape or selection pressures. Smith and Stirling (2008) highlight that the potential for socio-technical transitions depend on the articulation of selection pressures by regime members. Inversely, it has been found that regime reinforcing pressures and the articulation of regime reinforcing pressures create resistance to socio-technical change. Voß and Bornemann (2011) argue that the success of socio-technical transitions depends on coalitions of powerful actors that can stimulate strong selection pressures. Inversely,

this chapter highlights that coalitions of powerful actors aligned to incumbent regimes continually stimulate strong regime reinforcing pressures in defence of the regime.

Table 8.1: Classification of types and nature of regime risks

Type of regime risk	Nature of risk to incumbent regime
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Operational	<input type="checkbox"/> Risk to function of socio-technical regime
<input type="checkbox"/> Revenue	<input type="checkbox"/> Risk to the financial sustainability of socio-technical regime
<input type="checkbox"/> Values	<input type="checkbox"/> Risk to values underpinning socio-technical regime
<input type="checkbox"/> Political	<input type="checkbox"/> Risk to political support of the socio-technical regime
<input type="checkbox"/> Consumer	<input type="checkbox"/> Risk to consumer (end-user) use of socio-technical regime
<input type="checkbox"/> Professional-personal	<input type="checkbox"/> Risk to individuals involved in maintaining socio-technical regime
<input type="checkbox"/> Legal-regulatory	<input type="checkbox"/> Risk of non-compliance with socio-technical regime rules

Further, this chapter finds that if pressures for change are completely oppositional to the function, values (hegemonies) and financial model of the incumbent regime and the interests of organisational and political elites that protect the existing regime, power and value-driven struggles arise and conflicts over dominant values ensue. It appears that the greater the threat and risk to underlying regime logics, the stronger the resistance to change and accompanying regime reinforcing pressures may be.

Reflexive governance literature highlights that managing change requires experimentation, innovation and collective learning as a *modus operandi*, particularly in relation to non-linear sustainability challenges (Kemp and Loorbach, 2006; Prigogine, 1997). These characteristics underpin reflexive forms of governance such as adaptive management (Peterson et al., 2003) and transition management (Voß and Bornemann, 2011). Building on the previous chapter, which identified public niches, this chapter demonstrates that state institutions also need protective spaces in order to ‘incubate’ and provide supportive policies to private sector niches. On the other hand, this chapter highlights the difficulties for organisations involved in network infrastructure and service delivery to embrace experimentation and to adapt to rapidly changing conditions (selection pressures). There are several reasons for this.

First, the historical function of these organisations, to operate network infrastructure on tried and tested and fine-tuned processes, is the antithesis of experimentation. This function is hard-wired into their structure. Second, the structures which ensure competent service delivery including well-defined hierarchies and roles and a production line approach operate in opposition to the type of experimentation required for managing change. Third, it is evident that experimentation opens up significant risk (described above). These risks create an opposing reaction (regime reinforcing pressures) and result in a compliance culture that stifles innovation and prohibits experimentation. Four, experimentation and innovations threaten the values and interests that underpin regimes and the organisations that seek to reproduce these incumbent value systems. Finally, innovation and organisational space for innovation is constrained, restricted and actively prevented.

The above forms the basis of a critique of reflexive governance theories and the types of experimentation and innovation they propose (Voß and Bornemann, 2011; Kemp and Loorbach, 2006). As an alternative, it highlights the importance of examining the actual organisational realities that underpin key regime organisations with specific focus on the functions, values and rule systems of organisation. Notably, the findings illustrate the importance of examining the rationale for risk avoidance (uncertainty avoidance) in understanding the management of sustainable transitions. Such an approach requires greater interrogation of opportunities for change within the bounded rationalities of organisations (Simon, 1991), the positionality of actors and the decision-making nexus of regime members, including the information limitations, cognitive frames and practical realities of decision-makers.

### 8.3.5. Politics and power of transitions

Shove and Walker (2007a) argue that conflicts and power struggles are intrinsic to sustainability decision-making as it involves issues of resource distribution and access. However, sustainable transition authors, even those that explore power dynamics, have not classified types of power and the impact this has on transition dynamics. In this chapter a Weberian (1947) classification of different typologies of authority was applied within a transitions framework. The results indicate that core regime members and the organisational actors that support incumbent regimes apply rational-legal authority. Due to the pervasiveness and robustness of regimes, core regime members and 'subordinates' accept the 'legitimate authority' of regime rules and work to reproduce it. Conversely, change agents utilise power more closely aligned to charismatic authority, in attempts to persuade and argue for change based on 'moral imperatives' (Foster and Holleman, 2012).

Voß and Bornemann (2011) argue that in order to coherently explain the conditions under which transitions occur and progress, transition case studies need to grapple with the politics that underlie

a socio-technical regime. This chapter finds that politics shape, constrain and bound transitions in several ways. In response to the gap outlined by Voß and Bornemann (2011), this chapter identified a number of political conditions which either constrain or enable transitions. These include political change and electoral cycles, opposition politics, political interference and conflicting priorities between politicians and technocrats. The conceptual relevance of each of these requires further elaboration.

First, the long-term nature of planning required for transformation of infrastructure appears to collide with and is to some extent mutually exclusive with democratic checks and balances such as short-term electoral cycles, democratic political change and five-year planning cycles.

Second, there are conflicts between the technocratic approach, reminiscent of transition management, applied by green technocrats who seek socio-technical change exclusively on environmental criteria on the one hand and the political stratum that seek to, or at least require to be seen to, address the priority and needs of the urban poor and electorate on the other hand. Politicians thus tend to support transition initiatives that have benefits related to poverty alleviation, provision of livelihoods and job opportunities or health and well-being. In essence, democratic decision-making structures and the underlying value systems of political representatives influence and co-shape the framing, processes and prioritisation of transition actions.

It is evident that polity and political conflicts are elevated manifestations of the development and environmental priorities and contestation amongst different constituencies. Thus, different political groupings engaged in either regime reproduction or reconfigurations are also closely aligned to specific regime values and thus seek to actively uphold these values. This builds on arguments set out in preceding sections and chapters. In brief, values underpin not only the configuration of regimes but also the politics of sustainable transitions. Competing values inherent in regime structures create power tensions and conflicts which play out in larger political arenas. In brief, sustainable transitions are shaped by underlying regime values that are negotiated and contested in regulatory, organisational, as well as political settings.

Third, there are significant political tensions between national and local transformation agendas. As shown in preceding chapters, urban climate networks and specific departments in the City of CT actively push for decentralisation and devolution of authority based on, *inter alia*, a green decentralised urban agenda. On the other hand, national governments actively seek to uphold centralised socio-technical regimes for, amongst other reasons, their role in administering public goods. These political tensions between spheres of government occur due to a scalar mismatch of

political priorities. These tensions are particularly pronounced where the governing political party within a municipality differs from the national ruling party. This is specifically relevant to urban transitions due to the high prevalence of opposition governments in cities and the corresponding merging of green and decentralisation political agendas and tensions related to infrastructure.

Four, it is evident that, in the City of CT, processes of framing agendas and policies for socio-technical reconfigurations were not driven by participatory processes or proper engagement between technocrats, politicians and their constituencies. As shown in Chapter 7 there was very little attempt by technocrats to engage with community groups, social movements and grass-roots activists in defining transitions. It is thus indeed difficult to make 'democratic sense' of sustainability transitions (Smith and Stirling, 2008).

#### 8.4. Conclusion

This chapter sought to contribute to socio-technical transition theory by refocusing the lens of enquiry away from multiple, nested systems to the organisational level. In particular, it explored the role of local government and the organisational and political conditions within municipalities on socio-technical transitions. This led to several insights of relevance to sustainable transition theory.

First, it conceptually identified a category of organisations which may be termed key regime organisations. Such organisations may be defined as an organisation that is centrally involved with the operation and maintenance of a regime, but nonetheless has significant power to leverage socio-technical change, disrupt regimes, incubate niches, steer transitions and frame transition agendas. Related, this chapter explored the relationship between regimes and organisational function. This exploration highlighted that different social groupings play 'roles' in either actively inhibiting or driving socio-technical transitions based on their function. Opposing functions in turn result in functional conflicts that are underpinned by contested regime values.

Second, this chapter examined the impact of organisational structures on the potential, scope and framing of socio-technical transitions. Organisational structures that were explored, and their relationship with transition processes, included centralisation, formalisation of rules, division of labour (specialisation), departmentalisation, chain of command, incentives, budget and financial structures, supply chain structures and organisational capacity and continuity.

Third, this chapter explored the impact of organisational cultures and divergence in cultures on sustainable transitions. Elements of organisational culture included values; management style; knowledge; distance from power; and uncertainty avoidance. Notably, it highlighted that different organisational entities uphold, embody and defend wider socio-technical regime values. Thus,

regime values are central to the identity or act as an organising principle of divergent organisational cultures. The presence of divergent values results in value competition that in turn shapes transition agendas and potentials in several ways.

Four, this chapter explored the interplay between organisational risk and innovation. In this regard, types of risk experienced by the City in relation to socio-technical change were identified and discussed. These risks were conceptualised as forces that reproduce a regime, termed regime reinforcing pressures, the inverse of landscape pressures. The examination of organisational risk in turn led to a discussion on reflexive forms of governance and the relevance of such innovation-based modalities for municipalities in the Global South. In particular, the City provided a basis to critique these forms of governance related to insufficient attention on examining organisational realities.

Finally, this chapter briefly engaged with the broader issues of politics, policy and power. Notably, it highlighted that different political groupings engaged in transformation processes are closely aligned to specific socio-technical system values and hegemonies and thus seek to actively uphold these values. Accordingly, regime values underpin not only the configuration of regimes but also the politics of sustainable transition

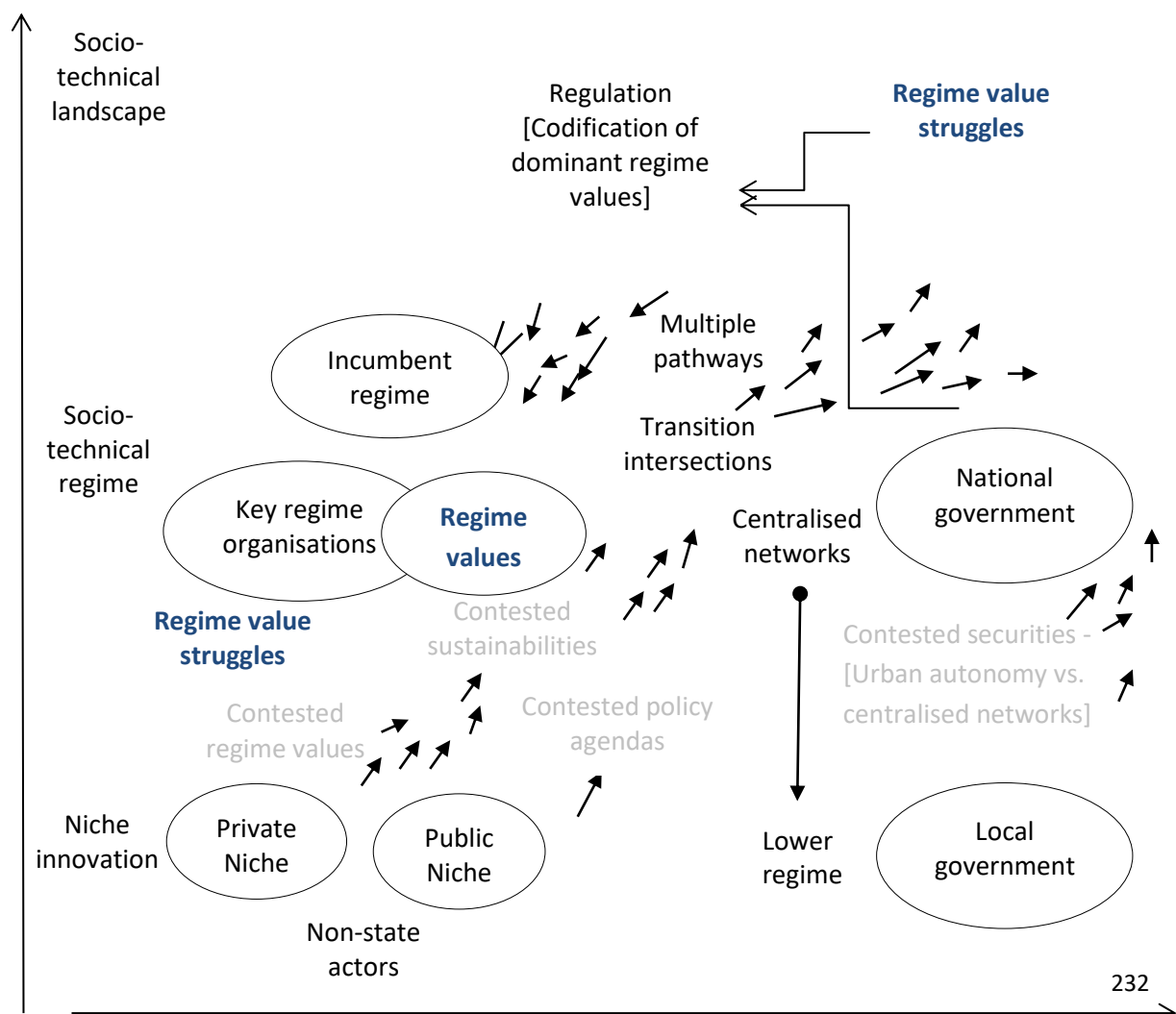


## Chapter 9: Conclusion

### 9.1. Introduction

The City of CT's energy transition provides a range of insights for understanding socio-technical systems and the conditions under which they transition to more sustainable configurations. First and foremost, the City's case demonstrated that values shape and underpin socio-technical regimes. In terms of such a conceptualisation particular values become integrated within the structure and function of socio-technical regimes (regime values). Regulatory systems are used as a tool to assimilate, codify and stabilise dominant value sets into regimes. Thus, during configuration processes, formal rules are used to entrench particular values within regimes and ensure their reproduction through enforcement of these value rules. Different social groups are aligned to divergent socio-technical system values and logics. These competing values create contestation within organisations in framing reconfiguration processes.

Figure 9.1: Values and conflict-driven conceptualisation of socio-technical regimes and transitions



In brief, socio-technical regimes may be (re)framed as systems of values. Rules codify these socio-technical values. Organisations and actors within organisations uphold, defend and drive particular socio-technical values. Thus, value tensions related to socio-technical systems are played out in regulatory, organisational and political landscapes. Notably, these competing value systems are integral in the co-evolutionary process of regime configuration and reconfigurations. Different socio-technical values are contested and compete for dominance. Once a specific value set dominates, it is codified in regulation and thereafter becomes integrated within regime structures.

The above summary of the central argument of this thesis requires further elaboration. The following sections accordingly provide a more detailed summation of the main findings and arguments of this thesis and its implications for sustainable transition research and the multi-level perspective.

## 9.2. (Re)framing transitions - perspectives from the Global South

This study drew on a range of interrelated concepts stemming from sustainable transition theory, which supported the analysis of the City of CT's energy transition. Notably, the study made use of the notion of technological regime, present in various sustainable transition frameworks, such as technological paradigms (Dosi, 1982), strategic niche management (Rip and Kemp, 1998), transition management (Rotmans et al., 2001), large technical systems (Hughes, 1987) and the MLP (Geels, 2002). This notion is highly relevant to the analysis of urban socio-technical regimes in the Global South.

Notably, examining the City of CT's electricity regime and processes and dynamics related to a transition of this socio-technical system provides a number of fresh insights for understanding regimes and their reconfigurations, of relevance for sustainable transition theory. First, a Global South context brought issues of values to the fore. Currently, sustainable transition theory conceptualises regime lock-in and reconfigurations as driven by macro processes. The role of values is not a significant part of this conceptualisation or analysis. In contrast, it is evident that the City's electricity regime has been structured to facilitate a range of developmental values such as redistribution, welfare and universal access to services. These were central to the way in which the City's incumbent electricity regime had been configured. Further, these values co-evolved alongside and influenced other regime elements of the City's electricity regime, including organisational and regulatory elements. This provides insight into the structure, co-evolution and configuration of regimes. It highlights that values both drive and are deeply entrenched in socio-technical regimes. This offers an alternative conceptualisation of regimes as systems that incorporate different sets of values.

Second, several authors argue that transition theories do not adequately pay attention to contestation in relation to regime configurations and reconfigurations (Shove and Walker, 2007a; Murphy, 2015; Genus and Coles, 2008; Lawhon and Murphy, 2011; Silver and Marvin, 2016). In the City of CT considerable contestation was present in relation to the nature, framing and outcomes of a nascent urban energy transition. Notably, contestation between developmental and environmental values was present. This in turn provided the basis for a conceptualisation of regime reconfigurations as tensions related to competing sets of values. These 'regime value tensions' are both systemic in nature and contested in policy agendas of socio-technical transitions. Thus, socio-technical regimes are produced and reproduced through value contestation. Such a conceptualisation, to some extent, fuses aspects of sustainable transition theory with Gramscian (1932) notions of conflict and hegemony in understanding the configuration and reproduction of regimes.

The nature of this contestation has an important relationship with geographic context. In the City of CT, based on a policy agenda to address systemic and historical inequality and poverty, developmental values were deliberately integrated into the incumbent electricity regime. However, the regime value systems that underpin and are contested would differ substantially depending on geographic context. This highlights that incumbent regimes, during evolutionary formation processes, integrate and maintain values and ideologies prioritised and rooted in a specific social, historical and political (geographic) context. These incumbent socio-technical values can potentially be threatened by the integration of newer regime values.

Notably, it is evident that contested reconfiguration policy agendas in the City's energy transition were manifestations of different elements of sustainability, i.e. environmental and social sustainability. A major critique of sustainability science and governance relates to a narrow conceptualisation of sustainability, which ignores contestation over 'sustainabilities' and seldom considers social, cultural and economic dimensions of sustainability (Agyeman et al., 2002). In response to these pitfalls, this thesis offered a multi-criteria framework for assessing and exploring sustainable transitions, in terms of process, timeframes, criteria and indicators. This broadened conceptualisation of 'sustainable' transitions is particularly important for examining sustainable infrastructure transitions in diverse contexts, where different dimensions of sustainability are prioritised.

Third, related to the above, a prevalent theme in energy transition cases is that 'disruption' of public infrastructure networks, through distributed energy or other private sector innovations (Geels, 2004; Rifkin, 2011), is a pre-condition for sustainable change. This sits within a theoretical underpinning related to neo-classical economics and trends of unbundling, corporatisation and

privatisation of network infrastructure prominent in the Global North (Murphy, 2015; Jaglin, 2008; Graham and Marvin, 2001). In contrast, it was evident that the City's electricity regime exhibited features of a social contract or a system to administer public goods and services. As a result, in the City of CT, the types of energy transitions common in theory, practice and policy, such as upscaling distributed energy and the implementation of smart technologies through unbundling and increased private sector competition, are resulting in not only the disruption of the incumbent technology structure, but also the ability of the City electricity regime to administer public goods and services.

This provides two important insights for sustainable transition theory and sustainability science and governance. First, it uses Hobbesian notions of social contract within the conceptualisation of socio-technical regimes and reiterates the role of network infrastructure as systems to administer public goods (Jaglin, 2008; Satterthwaite, 2007, Savage and Ward, 2003; Grubb and Wilde, 2008). Second, it highlights the contestation between green niche technologies and centralised 'developmental-focused' networks and the disjuncture of reconfigurations of network infrastructure based solely on green, private sector innovations in the Global South. Sustainable transitions within a 'public goods' framing would thus not be achieved merely through disruption and competition processes of private green niches, but rather a process of contestation and (re)negotiating of social contracts and political economies that underpin socio-technical infrastructure.

Finally, examining a socio-technical regime in the Global South highlights certain biases in sustainability governance and transition policy. Through examining contestation in reconfiguration policy agendas in general and two projects in the City that embody these contested agendas in particular, namely SSEG (green agenda) and electrification (social agenda), three interconnected biases were identified and the associated conceptual implications of these biases were explored. These were geographic (Northern), technical and green. This provides two insights for sustainable transition theory and broader sustainability science and governance literature. First, it demonstrated that regime value tensions become particularly acute when transition tools that are rooted in contexts where specific regime values are prioritised are indiscriminately used in contexts where different regime values are prioritised. Notably, it illustrated that transfer of transition tools from the Global North to Global South would tend to benefit the wealthy at the expense of the urban poor, resulting in a reproduction of the incumbent 'political economy'. Second, in contrast, the example of electrification demonstrated that transition initiatives based solely on social criteria would qualify as a transition. Thus, it demonstrated that innovative government policy responses, South-South transfer, technological innovations with social sustainability benefits and innovations arising from challenges in the informal sector provide robust cases of innovation that may disrupt

an incumbent regime. This reinforces an argument for widening the lens of enquiry, cases and the definition of sustainable transitions.

### 9.3. (Re)defining transition pathways and typologies in the Global South

This study sought to contribute to debate on the conditions under which socio-technical regimes change (Smith and Stirling, 2010; Geels, 2004); and potential pathways and typologies of reconfigurations (Geels and Schot, 2007; Berkhout et al., 2004). Four linked insights and conceptual contributions were sought in this regard. First, in order to explore the conditions under which regimes change, the history of the City's electricity regime and successive reconfiguration processes were described. This exploration highlighted the important role of collective action by networks, civil society and interest groups (Genus and Coles, 2008; Lawhon and Murphy, 2011) in fracturing regimes and creating fertile ground or pathways for change. Further, it found that underlying 'regime value struggles' both precede and provide the conditions that make reconfigurations possible. This challenges the structuralism inherent in conceptualisation of regimes and the preeminent role of niche innovations in creating pathways for change implied by a range of interrelated sustainable transition frameworks, include innovation studies, technological innovation system theory and the MLP. Rather, the City of CT's energy transition to an extent frames transitions as processes of collective action rupturing socio-technical hegemonies and opening up space for new socio-technical values and belief systems to take root

Related to the above, the role of the state in transitions was explored. In contrast to the prominence of niche (private sector) disruption in competitive, deregulated and liberalised infrastructure markets in the Global North (Murphy, 2015), it was found that electricity reconfigurations in Cape Town were driven and dependent on the City of CT (state). This led to a conceptual distinction between private and public-led transitions. Further, the notion of 'public niches', defined as nodes in the state with the sole function of facilitating regime reconfigurations through public innovation, was developed. It was argued that interactions between private and public niches (state intervention) disrupt regimes and facilitate transitions. Related, it was shown that the City (state) actively 'selected' and mainstreamed a set of nascent niche technologies in efforts to cultivate an envisioned alternative regime. This, rather than quasi-evolutionary forces (Geels, 2010) provided opportunities for firms to compete with incumbent technologies. Thus, it can be said that these public niches play a role as 'system builders' and weaving a 'seamless web' (Hughes, 1987) by aligning policy, technical, social and economic elements of an envisioned socio-technical regime.

Second, sustainable transition theory often overlooks the socio-economic outcomes or the political economy of transitions (Meadowcroft, 2009; Kaghan and Bowker, 2001). In response, this study

applied a constructivist approach to transitions (Shove and Walker, 2007a) through exploring multiple potential energy transitions in the City of CT that would create radically different socio-technical and socio-economic configurations and outcomes. Two potential scenarios were explored, a large centralised supply-driven option or a decentralised demand-side-driven option. These scenarios provided the basis for a model to explore and evaluate the socio-economic expressions of sustainable transitions. Notably, particular indicators for examining different reconfiguration pathways were identified and examined. These include resource control and ownership, socio-economic indicators (including jobs), access, modes of thought and principles underlying decision-making, realignment of power and behavioural and cultural shifts in relationship to technology. Related, a model to assess the outcomes of reconfigurations according to the reproduction or change of the incumbent political economy was developed, with a focus on the impact of reconfigurations on the poor, wealthy and middle class. These provide tools to explore the 'winners and losers' (Myers, 2014b; Zimmerer and Bassett, 2003; Monstadt, 2009) of sustainable reconfigurations and the extent to which the incumbent political economies are reproduced during reconfiguration processes.

Overall, the exploration into the socio-economic expressions of trajectories of the City's energy transition achieved three conceptual aims. First, it to some extent reconciled a social construction of technology (SCOT) approach with sustainable transition theory, as recommended by Genus and Coles (2008) and Kaghan and Bowker (2001), whereby issues such as social impact, access and equity of particular trajectories are dissected in transition analysis. Second, the City's case provides an empirical basis for a model to explore multiple potentialities and the open-ended character of the development of technology (Meadowcroft, 2009; Huesemann and Huesemann, 2011). Finally, it conceptually identified points in time, labelled 'transition intersections', at which multiple potential transition trajectories are possible. Such an approach is important in transition analysis in Global South contexts where multiple potential development pathways are conceivable, in contrast to the prescriptive ecological modernist leanings common in sustainability science, practice and policy.

Third, various frameworks rooted in transition theories, such as technological innovation systems and the MLP do not adequately consider the conditions under which socio-technical regimes may become rapidly unravelled and the associated social, political and economic ramifications of socio-technical regimes in states of disequilibrium. This thesis provided a description of the causality for change in regimes through outlining three different pathways namely: 'positive feedback', 'tipping point' and 'cascading pathways'. These employ and merge concepts from both dynamic systems thinking and conflict theory. Notably, the scenarios highlight that regime transformations may arise

because socio-technical systems may contain within themselves tensions and contradictions which may result in their collapse (Foster, 1999). These classifications are particularly relevant to the Global South where network infrastructure, which often plays a critical role in development, may be under considerable pressure.

Finally, typologies of reconfigurations outlined by Geels and Schot (2007) and Berkhout et al. (2004) neglect a number of variables present in Global South contexts. In response, the City offers insights into the nature and structure of reconfigurations in Global South contexts. Notably this thesis develops theoretical reconfiguration classifications that conceptually consider the competing values inherent in regime structures and the outcomes of different transformation scenarios. It identifies four conceptual transformation scenarios of relevance to Global South contexts, namely: 'gated green transformation', 'social grey transformation', 'business-as-usual' or 'integrated sustainability transformation'. These extend reconfiguration typologies developed by Geels and Schot (2007) to Global South contexts. Notably, a gated green transformation expands the concepts of 'splintered urbanism' (Jaglin, 2008; Graham and Marvin, 2001) and differentiated infrastructure provision (Savage and Ward, 2003; Murphy, 2015) to transitions based solely on environmental efficiency, at the expense of development goals embedded in network infrastructure. The result of such a transformation is a well-serviced, modern and increasingly 'green' infrastructure provision to middle and high income citizens on the one hand and sprawling informal settlements without access to infrastructure services on the other (Pieterse, 2011).

#### 9.4. Regulation, regimes and (re)configurations

This thesis sought to examine the relationship between regulation and socio-technical regimes. Exploring this theme in the City of CT provides a number of interconnected insights for understanding socio-technical regimes and the conditions under which they change. First, the role of rules in shaping regime stability and reproduction (Geels, 2004) was empirically tested through evaluating the ways in which top-down regulatory frameworks have shaped the City's electricity regime. Notably, these top-down rules, developed by policy-makers and regulators, were underpinned by specific values, modes of thought and principles. This demonstrated that regulation consolidates regime authority and power and is used as a means to lock in regimes and the particular values which underpin regimes. In brief, rules codify, entrench and stabilise the value sets that underpin regimes. Different values and hegemonies are contested and negotiated and compete for primacy in political arenas. Once a specific value set dominates or gains political priority, it is codified in regulation and becomes integrated and inherent within regime structures.

Such an understanding of regulation is well suited to the quasi-evolutionary conceptual underpinning of socio-technical system thinking.

Second, the above also has implications for understanding the relationship between national and urban transitions. In essence, it is evident that the regulatory system is commonly used as a tool to reproduce centralised control of network infrastructure that is nationally-bounded as well as the political economy and regime values that underpin national socio-technical network infrastructures. This notably constrains urban transition agendas that do not align with or negatively impact on the mode of thought, regime values or the political economy embedded in nationally configured socio-technical regimes and regime policy reconfiguration agendas.

Third, this thesis sought to explore alignment between rules and other elements and rule coherence (Genus and Coles, 2008; Geels, 2004). In the City of CT, it was found that top-down rules, developed by regulators and policy-makers, aimed at regulating change, commonly interfered with the City's electricity regime or its subsystems and the corresponding values that are underpinned by its electricity regime. This in essence highlighted that regulation developed in a top-down manner aimed at facilitating socio-technical change results in tensions in circumstances where they do not align with internal regime logics, interfere with regime functions or interfere with regime values, all of which are integrated into a regime structure. Further, different categories of temporal disjunctures in rules were identified. These highlighted the misalignments between rules and other regime elements during reconfiguration processes. This offers insight into the timing of configuration and reconfiguration processes through showing disjunctures between rules on the one hand and technology, organisations and values on the other.

Four, this thesis sought to explore the way in which rules are produced and reproduced, refined (Geels, 2002) and modified in organisational settings. This sought to link the organisational and regulatory themes of this study. Notably, in the City of CT, it was evident that implementing agents interpret rules according to the value systems that they hold and to which they are organisationally aligned. If actors seek to protect the incumbent regime and the values that they embody then they interpret rules conservatively. Conversely, if change is sought, rules are interpreted opportunistically. Related, it was found that top-down regime rules are often incompatible with the priorities of key regime organisations, as they may contain and codify opposing values to those held by implementing agents.

Finally, in the City, it is evident that, in response to top-down rules, implementing agents apply bottom-up responses that ensure the maintenance of the regime values they uphold. Notably, they develop context-specific responses, adapting international standards to local needs, interpreting



and adjusting rule systems to suit contextual priorities and through lobbying rule-makers for increased mandates to implement according to local contexts. Thus, regime rules and values are enforced from both top-down (through regulation) and subsequently bottom-up (through interpretations and bottom-up responses aligned to regime logics) processes. These processes serve as a selection environment whereby regime rules that do not align with regime values are weeded out.

## 9.5. Organisations and (re)configurations

The final theme of this thesis sought to explore the role of local government and the organisational and political conditions within municipalities on socio-technical transitions. First, it was found that the City has considerable agency, or capacity and capability (Smith and Stirling, 2008), to either influence the reproduction of regimes or govern or leverage socio-technical change. This organisational capacity was conceptually labelled a 'key regime organisation'. This refers to an organisation that is centrally involved with the operation and maintenance of a regime, but nonetheless has significant power to leverage socio-technical change, disrupt regimes, incubate niches, steer transitions and frame transition agendas.

Second, this study explored the relationship between regimes and organisational functions in key regime organisations. In the City of CT it was evident that different social groupings play 'roles' in either actively inhibiting or driving socio-technical transitions based on their function. Opposing functions in turn result in 'functional conflicts' that are underpinned by contested regime values.

Third, this thesis highlighted that different organisational entities in the City internalise and defend wider socio-technical regime values. Thus, regime values are central to the identity or act as an organising principle of divergent organisations and their corresponding functions. The presence of divergent values results in 'value competition' that in turn shapes transition agendas and potentials in several ways. Notably, this thesis highlighted that, if selection pressures for change threaten regime values internalised in organisational entities, power and value struggles arise and conflicts over dominant values ensue. Multiple pressures and risks associated with socio-technical change in the City were identified and categorised. These risks were conceptualised as forces that reproduce a regime, termed 'regime reinforcing pressures', the inverse of landscape pressures.

Finally, this thesis demonstrated that different political groupings engaged in transformation processes are closely aligned to specific socio-technical system values and hegemonies and thus seek to actively uphold these values. Thus, regime values underpin not only the configuration of regimes but also the politics of sustainable transitions. Phrased differently, contested regime values

inherent in regime structures thus create 'regime value struggles' and conflicts, which play out in larger political arenas.

## 9.6. Urban and national regimes and (re)configurations

The urban and scalar theme of this study cuts across the other themes of this study. In general, examining a socio-technical regime in the Global South highlighted a range of spatial and scalar dynamics that provide insight into the relationship between cities (municipalities) and the niche-regime-landscape hierarchy. First, it was demonstrated that national socio-technical infrastructure regimes are highly entangled, not only with municipal socio-technical infrastructure regimes, but also municipal functions and the structure of cities in general. In this way, the functional systems of cities were conceptualised as extensions of and reinforcing instruments of national socio-technical regimes. In this way, urban socio-technical regimes both mirror and reinforce underlying modes of thought, logics and functions of national socio-technical infrastructure regimes.

Second, the MLP is silent on the modes and means in which urban actors govern change and how these processes interact with the landscape-regime-niche (Hodson and Marvin, 2009b). In response, this thesis identified and examined the presence of multi-level governance modalities occurring alongside socio-technical regime structures. It highlighted that urban actors, both within and outside the City of CT, operate within and alongside regime structures in fluid networks in order to sidestep institutional conditions that obstruct transitions. This to some extent applies approaches stemming from multi-level climate change governance studies (Bulkeley and Betsill, 2005; Hooghe and Marks, 2003) to examine change in socio-technical regimes.

Third, this thesis finds that urban transitions may enhance value tensions and reconfiguration processes at larger scales. Notably, this study highlighted the presence of contested securities between the developmental state, with nationally-bounded infrastructure policy priorities on the one hand and an urban transition based on autonomy and ecological security on the other. In this regard, it was found that urban transitions based solely on ecological securities (or environmental values) may potentially disrupt national regimes and underlying social contracts structured to administer public goods and distribute resources along national boundaries. It found that there is not only 'spatial patchiness' (Coenen and Truffer, 2012) in relation to progress in transitions vis-à-vis Cape Town and other urban and rural areas, but rather, an urban transition in the City may enhance such patchiness. This highlights that urban ecological securitisation, the basis of transitions, has an inherent consequence of bounding, limiting and protecting the interests of urban citizens at the expense of regional or national interests. The outcome of urban transitions in already splintered cities (Jaglin, 2008) may thus be infrastructure enclaves characterised by 'green, smart,

efficient cities' surrounded by regions of infrastructure poverty. This highlights the nested nature of contestation in transition processes and the ways in which scale, socio-economic development, sustainability and geography (Global South) are significantly coupled. This in turn contributes to wider debates related to decentralisation of control of network infrastructure in urban transition analysis (Hodson and Marvin, 2009a; Murphy, 2015).

### 9.7. (Re)flections on the case and methods for exploring urban transitions in the Global South

The methodological strategy adopted in this study was a novel approach to exploring socio-technical systems. Participant observation and knowledge co-production were particularly useful in exploring a socio-technical regime in a context of socio-economic diversity. A foundational rationale of knowledge co-production stems from critiques related to the limitation of less engaged research methods for exploring complex and interdisciplinary themes (Brown-Luthango, 2013; Gibbons, 2000; Patel et al., 2015). Knowledge co-production thus facilitates precisely the types of learning spaces that are necessary for exploring complex and coupled systems, such as socio-technical regimes. Knowledge co-production is, moreover, a valuable approach to 'learning the City' (Greyling *et al.*, 2016) and provides unique opportunities to excavate the rich tacit knowledge possessed by practitioners actively involved in the reconfiguration of network infrastructure.

Being in an embedded position enabled the collection of rich data and insights on an urban socio-technical regime, from a unique vantage point. Notably, the value of knowledge co-production in building trust and credibility, facilitating access to multiple sources of quality data, and creating opportunities to triangulate and 'reality check' concepts cannot be overstated. Further, the principles of knowledge co-production align closely to the grounded approach employed in this study. Importantly, both stress the value of regarding participants as co-generators of knowledge. This is invaluable for investigating themes that are complex and interdisciplinary in nature, where grounded knowledge may enrich a researcher's understanding of a socio-technical system.

Notably, being embedded in the City of CT, a single organisation, had both positive and negative implications for exploring sustainable transitions. Notably, being in an embedded position meant that data from fieldwork was limited to government officials and the broader yet still confined network of actors that these officials engage with. Although officials across directorates and departments were engaged with throughout the duration of the study, the bulk of participation was with officials in the Environmental Management Department (change agents) and in the Electricity Department (infrastructure managers). The strength of this approach is that it results in an in-depth account of a socio-technical regime and transition process from within an organisation

involved in reproducing, maintaining and in some instances changing the regime. This enables an understanding of the way in which the regime is constructed, its internal logics and its bounded rationalities, from within. However, the limitation of this approach is that it restricts access to data that supports an understanding of transition potentials and pathways from the perspective of 'outside' actors. In essence, my field work did not focus on the perceptions of actors such as residents, companies and electricity users' vis-à-vis the existing electricity system, perceptions on service delivery and potentials for transition processes. Notably, the field work did not engage with the kind of socio-technical configurations that could support the aspirations of people living in informal settlements, from the position of residents and communities in informal settlements. Field work was, instead, limited to a particular grouping within the incumbent socio-technical regime. This, obviously, forecloses an understanding of socio-technical regimes and corresponding transition pathways from the vantage point of those who are suffering from lack of access to the benefits, services and opportunities of a particular socio-technical configuration.

Finally, this thesis attempted to reflect on sustainable transitions from a unique perspective, from a city in the Global South. There are several pitfalls to using Cape Town as an example of an African city or a city in the Global South, due to its history, resource abundance, relatively lower proportions of residents living in informal settlements, and corresponding higher proportion of formal housing and infrastructure systems (McDonald, 2008). Thus, many features typical of Global South socio-technical regimes may not be adequately represented in Cape Town. On the other hand, it is apparent that Cape Town, with its apartheid legacy of intense infrastructure and energy inequality, is a site that particularly lends itself to understanding network infrastructure or socio-technical regimes as systems of values, contestation, conflict and hegemonies. The City of CT is thus a powerful outlier case and was strong site to explore the implications of sustainable transitions in a unique Global South context.

## 9.8. (Re)lections on future research on urban transitions in the Global South

The themes and findings of this thesis bring to the fore interesting questions for future studies on urban socio-technical transitions in the Global South. First, in relation to socio-technical systems in the Global South, rich insight may be gained from research from the position of marginalised groups that are critically impacted by the structure of a socio-technical regime, but have limited agency to steer change. This may result in novel representations and conceptualisations of socio-technical regimes and further insights into the beneficiaries and losers (Myers, 2008; Jaglin, 2008) of both incumbent regime configurations and reconfiguration processes. There is furthermore wide scope for exploring socio-technical regimes through the lens of conflict theories. Notably, transition

theories may benefit considerably from research and cases that engage with and examine issues such as class, gender and race in understanding socio-technical change.

Second, there is considerable opportunity for future research into the relationship between rules and socio-technical regimes. This thesis focused primarily on formal rules or regulatory instruments. Transition theories, including the MLP and innovation management may benefit considerably from an analysis of different rule systems such as cultural rules or market rules. The latter, in particular, has by and large been absent in conceptual and empirical research in sustainable transition studies.

Third, this thesis explored the organisational level vis-à-vis its relationship with socio-technical reproduction and change. However, this examination was from the perspective of only one category of organisation, a municipality. There may be substantial insights that arise from exploring a range of organisations and their impact on the maintenance or change of regimes including utilities, regulators, not-for-profit organisations and research institutions.

The investigation of the relationship between national and urban transitions brings a host of questions to the fore with particular focus on investigating the implications of urban transitions. Questions for future research that were brought to the fore in this study include *inter-alia*: in what ways, if any, do urban transitions impact or constrain national transitions? What is the impact of urban bounded transitions on regions and poorer cities? In defining transitions along urban boundaries, who is excluded from the benefits of reconfiguration processes? These questions are particularly relevant in relation to the capacity of wealthier cities to coordinate and mobilise resources for transitions at the expense of poorer regions and cities.

## Appendix 1: List of meetings and workshops attended as part of participant observation

Key:

Recording method: TR = Recorded; FT = Fully transcribed; N = Notes taken; EM = Existing minutes

1. MTG1. CCT Energy and Climate Change Unit. *Electricity Savings Campaign meeting* (N), 20 April 2012
2. MTG2. CCT Environmental Resource Management Department. *Management Meeting on Fiscal Reform* (N), 23 April 2012
3. MTG3. CCT Energy and Climate Change Unit. *Meeting on energy governance themes in Cape Town* (N), 04 May 2012
4. MTG4. Electricity Governance Initiative (EGI). *Meeting on smart electricity planning* (N), 20 June 2012
5. MTG5. CCT Human Settlements Directorate. *Meeting on energy efficiency in new municipal building* (N), 21 June 2012
6. MTG6. Electricity Governance Initiative (EGI). *Meeting on smart electricity planning* (N), 29 June 2012
7. MTG7. Western Cape Provincial Government (WCPG). *Meeting on energy-water- food security* (N), 12 July 2012
8. MTG8. CCT Energy and Climate Change Unit. *Minutes of public briefing on Solar Water Heater Roll-out* (EM), 13 July 2012
9. MTG9. CCT Energy and Climate Change Unit. *Meeting on Santam involvement in Energy Efficiency Forum* (N), 17 July 2012
10. MTG10. CCT Economic, Environmental and Spatial Planning Directorate. *Meeting on EESP comments on Eskom Multi-year Price Determination* (N), 19 July 2012
11. MTG11. CCT Environmental Resource Management Department. *Meeting on wind energy and biodiversity conflicts* (N), 20 July 2012
12. MTG12. CCT Energy and Climate Change Unit. *Meeting on EEDSM Programme* (FT), 26 July 2012
13. MTG13. CCT Energy Efficiency Forum. *Energy Efficiency Forum* (N), 1 August 2012
14. MTG14. CCT Energy and Climate Change Unit. *Meeting on Energy Action Plan Prioritisation* (FT), 02 August 2012

15. MTG15. CCT Energy and Climate Change Unit. *Meeting on EEDSM and Eskom IDM Offerings Support Project* (N), 08 August 2012
16. MTG16. Sustainable Energy Africa. *Meeting on City Revenue Impacts of embedded generation* (FT), 08 August 2012
17. MTG17. Energy Research Centre. *Workshop on transition to low carbon city* (FT), 10 August 2012
18. MTG18. Sustainable Energy Africa. *Meeting on urban energy governance* (N), 14 August 2012
19. MTG19. CCT Energy and Climate Change Committee. *Energy and Climate Change Committee Meeting* (EM), 16 August 2012
20. MTG20. Cape Peninsula University of Technology. *Meeting on solar energy and urban planning* (N), 22 August 2012
21. MTG21. CCT Energy and Climate Change Unit. *Meeting on REEEP and municipal energy efficiency* (N), 03 September 2012
22. MTG22. CCT Waste Department. *Meeting on City Sewage and Biogas Feedstock* (N), 03 September 2012
23. MTG23. CCT Planning and Building Development Management Department. *Meeting on Resource Efficient Development Policy* (FT), 04 September 2012
24. MTG24. Sustainable Energy Africa. *Meeting on Fiscal Commission Technical Report* (N), 05 September 2012
25. MTG25. CCT Finance Directorate. *Meeting on Energy Management Financing with Director: Budgets* (FT), 07 September 2012
26. MTG26. Electricity Governance Initiative (EGI). *Meeting on urban energy modelling* (N), 12 September 2012
27. MTG27. CCT Energy and Climate Change Committee. *Energy and Climate Change Committee Meeting* (EM), 13 September 2012
28. MTG28. Electricity Governance Initiative. *Meeting on urban energy planning* (N), 14 September 2012
29. MTG29. CCT Energy and Climate Change Unit. *Meeting with Arup (Pty) Ltd on SSEG* (N), 20 September 2012
30. MTG30. CCT Heritage Resource Management Branch. *Meeting on resource efficient technologies in heritage areas* (N), 25 September 2012
31. MTG31. CCT Electricity Department. *Meeting on City energy data management* (N), 25 September 2012

32. MTG32. CCT Electricity Department. *Meeting with Electricity Department* (N), 26 September 2012
33. MTG33. CCT Energy Efficiency Forum. *Energy Efficiency Forum and Market-place meeting* (N), 04 October 2012
34. MTG34. CCT Transport Directorate. *Energy and Transport Month Meeting* (N), 09 October 2012
35. MTG35. Electricity Governance Initiative. *Meeting on smart electricity planning* (N), 12 October 2012
36. MTG36. CCT Planning and Building Development Management Department. *Meeting on solar PV and SWH planning and building approvals* (N), 24 October 2012
37. MTG37. Green Building Council of South Africa. *Meeting on green developments in Cape Town* (N), 25 October 2012
38. MTG38. CCT Waste Department. *Meeting on bio-energy and the Philippi Horticultural Area* (N), 01 November 2012
39. MTG39. CCT Energy and Climate Change Committee. *Energy and Climate Change Committee Workshop* (N), 09 November 2012
40. MTG40. CCT Energy and Climate Change Unit. *Workshop on urban Energy Policy Development* (FT), 19 November 2012
41. MTG41. CCT Energy Efficiency Forum. *Energy Efficiency Forum and Market-place* (N), 29 November 2012
42. MTG42. CCT Planning and Building Development Management Department. *Meeting on urban resource efficiency tools* (FT), 04 December 2012
43. MTG43. Energy Research Centre. *Meeting with Energy Research Centre* (N), 11 December 2012
44. MTG44. CCT Environmental Resource Management Department. *Meeting on resource efficient development and WDC2014* (N), 12 December 2012
45. MTG45. CCT Energy and Climate Change Unit. *Meeting on revenue loss from distributed generation* (FT), 13 December 2012
46. MTG46. CCT Energy and Climate Change Unit. *Meeting on energy retrofits in municipal buildings* (N), 19 December 2012
47. MTG47. CCT Energy and Climate Change Unit. *Meeting on energy visions (long-term energy plan)* (FT), 16 January 2013
48. MTG48. CCT Energy and Climate Change Committee. *Minutes of Energy and Climate Change Committee workshop* (EM), 17 January 2013
49. MTG49. CCT Energy and Climate Change Committee. *Minutes of Energy and Climate Change Committee meeting* (EM), 17 January 2013



50. MTG50. CCT Strategic Policy Unit (SPU). *Meeting on energy policy and Integrated Development Plan* (N), 29 January 2013
51. MTG51. National Treasury. *Meeting on unblocking regulatory barriers in the MFMA and PFMA* (FT), 08 February 2013
52. MTG52. Sustainable Energy Africa. *Meeting on AMEU conference paper* (N), 12 February 2013
53. MTG53. CCT Energy and Climate Change Unit. *Meeting on City 5 Year Energy Efficiency Plan* (N), 12 February 2013
54. MTG54. GreenCape. *Minutes of Smart Grids workshop* (N), 14 February 2013
55. MTG55. CCT Planning and Building Development Management Department. *Meeting on guidelines for resource efficient technologies* (N), 15 February 2013
56. MTG56. CCT Energy and Climate Change Unit. *Meeting on energy savings in municipal efficiency programmes* (N), 22 February 2013
57. MTG57. CCT Energy Efficiency Forum. *Meeting on Energy Efficiency Forum and SAPOA* (N), 26 February 2013
58. MTG58. CCT Legal Services Department. *Meeting on energy related legal opinions* (FT), 06 March 2013
59. MTG59. Energy and Climate Change Unit. *Meeting on Energy Visions 2040* (FT), 08 March 2013
60. MTG60. National Treasury. *Meeting on legal interpretations of MFMA and PFMA* (N), 20 March 2013
61. MTG61. CCT Planning and Building Development Management Department. *Meeting on planning laws and renewable energy* (FT), 27 March 2013
62. MTG62. CCT Environmental Resource Management Department. *Meeting on City comments on Provincial Government Green Economy Policy* (N), 10 April 2013
63. MTG63. CCT Energy and Climate Change Committee. *Energy and Climate Change Committee meeting* (EM), 11 April 2013
64. MTG64. CCT Planning and Building Development Management Department. *Meeting on energy efficient building regulations* (FT), 11 April 2013
65. MTG65. CCT Strategic Policy Unit. *Meeting on Draft City Economic Growth Strategy* (N), 12 April 2013
66. MTG66. CCT Energy Efficiency Forum. *Energy Efficiency Forum meeting* (EM), 18 April 2013
67. MTG67. Energy and Climate Change Unit. *Meeting on Energy Visions 2014* (FT), 19 April 2013
68. MTG68. Cape Town Partnership. *Workshop on Low Carbon City Centre Strategy* (N), 23 April 2013
69. MTG69. City of Munich. *Meeting on Munich-Cape Town Energy Partnership* (N), 23 April 2013

70. MTG70. CCT Planning and Building Development Management Department. *Meeting on energy efficient building regulations* (N), 25 April 2013
71. MTG71. CCT Legal Services Department. *Meeting on legal uncertainties and opinions in urban energy matters* (FT), 10 May 2013
72. MTG72. CCT Electricity Department. *Meeting on City energy data and carbon management policy* (N), 5 June 2013
73. MTG73. CCT Energy and Climate Change Unit. *Meeting on urban energy policy* (N), 12 June 2013
74. MTG74. CCT Energy and Climate Change Committee. *Energy and Climate Change Committee meeting* (EM), 13 June 2013
75. MTG75. CCT Energy and Climate Change Unit. *Meeting on SSEG study* (FT), 13 June 2013
76. MTG76. CCT Electricity Department. *Meeting on Cape Town energy data analysis* (N), 19 June 2013
77. MTG77. CCT Planning and Building Development Management Department. *Meeting on resource efficient development* (N), 19 June 2013
78. MTG78. Sustainable Energy Africa (SEA). *Meeting on solar PV and revenue loss* (FT), 21 June 2013
79. MTG79. GreenCape. *Meeting on energy policy and regulation* (N), 25 June 2013
80. MTG80. Sustainable Energy Africa. *Meeting on solar PV modelling and tariffs* (N), 04 July 2013
81. MTG81. CCT Electricity Department. *Meeting on SSEG and City tariff principles* (FT), 05 July 2013
82. MTG82. CCT Energy and Climate Change Unit. *Meeting on barriers to energy projects in municipal finance regulation* (N), 08 July 2013
83. MTG83. CCT Planning and Building Development Management Department. *Meeting on international resource efficient planning laws* (N), 12 July 2013
84. MTG84. CCT Electricity Department. *Minutes of municipal energy management workshop* (N), 19 July 2013
85. MTG85. Electricity Governance Initiative. *Minutes of Smart Electricity Plan meeting* (N), 23 July 2013
86. MTG86. CCT Environmental Resource Management Department. *Meeting on City comments on National Carbon Tax Policy Paper* (N), 23 July 2013
87. MTG87. CCT Executive Management Team. *Workshop on municipal energy management* (N), 25 July 2013
88. MTG88. CCT Energy and Climate Change Unit. *Meeting on energy data collaboration* (N), 26 July 2013

89. MTG89. CCT Environmental Resource Management Department. *Meeting on Cape Town's Resilient Cities Programme* (N), 15 August 2013
90. MTG90. CCT Energy and Climate Change Committee. *Energy and Climate Change Committee meeting* (EM), August 2013
91. MTG91. CCT Executive Management Team. *Municipal Energy Management Transversal Workshop* (N), 21 August 2013
92. MTG92. South African Bureau of Standards. *Workshop on ISO Energy Management System* (N), 03 September 2013
93. MTG93. CCT Utilities Directorate. *Workshop on Energy and Climate Action Plan Progress* (N), 12 September 2013
94. MTG94. CCT Utilities Directorate. *Workshop on Energy and Climate Action Plan Progress* (N), 13 September 2013
95. MTG95. CCT Energy and Climate Change Unit. *Meeting on ISO 50001 Energy Management Training* (N), 18 September 2013
96. MTG96. CCT Energy and Climate Change Unit. *Meeting with Siemens and Arup on Energy Visions* (N), 20 September 2013
97. MTG97. CCT Energy and Climate Change Unit. *Meeting on Policy Shaping* (N), 09 October 2013
98. MTG98. CCT Energy and Climate Change Committee. *Energy and Climate Change Committee Meeting* (N), 10 September 2013
99. MTG99. Energy Research Centre. *Meeting on tariffs and energy research* (FT), 12 February 2014
100. MTG100. CCT Energy and Climate Change Unit. *Meeting on energy policy* (N), 28 February 2014
101. MTG101. Cape Town Partnership. *Meeting on Low Carbon City Centre* (N), 03 March 2014
102. MTG102. CCT Energy Efficiency Forum. *Energy Efficiency Forum Meeting* (N), 06 March 2014
103. MTG103. Western Cape Provincial Government. *Integrated Energy Strategy Workshop* (N), 07 March 2014
104. MTG104. CCT Strategic Policy Unit. *Internal Energy Management Workshop* (N), 11 March 2014
105. MTG105. City of Munich. *Munich-Cape Town Partnership Workshop* (N), 24-27 March 2014

## Appendix 2: Interview schedule

Key:

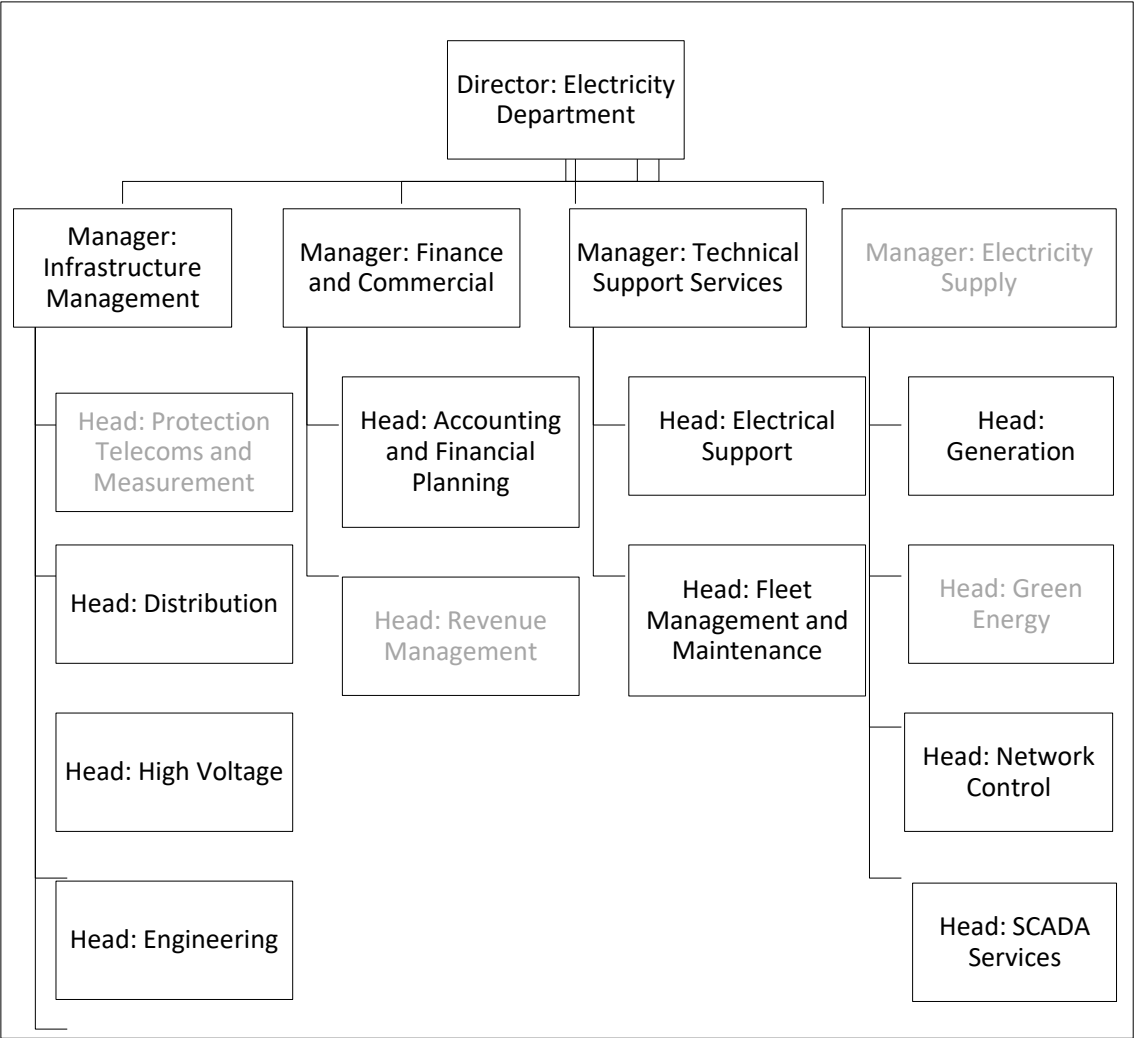
Interview details: date / duration (minutes) / recording method (TR = Recorded; FT = Fully transcribed; N = Noted) / style of interview (IF = Informal, SS = Semi-structured, S = Structured)

No.	Job title	Organisation/directorate/ department/unit	Interview details
1.	Director: ERMD	CCT/EESP/ERMD	06/02/2013 / 30 Mins / N / IF
2	Policy Researcher	CCT/ Office of the Executive Mayor: Strategic Policy Unit	05-06-2013 / 25 Mins / N / IF
3	Technical Director	Sustainable Energy Africa	07-06-2012 / 30 Mins / IF / N
4	Head: Land-use Management	CCT/EESP/PBDM	31-10-2013 / 30 Mins / IF / N
5	Project Manager	Sustainable Energy Africa	11-04-2012/ 15 Mins / IF / N
6	Manager: Technical Strategic Support	CCT/Utilities Directorate	3-09-2013 / 30 Mins / SS / R and FT
7	Programme Manager Policy and Research	Electricity Governance Initiative / Project 90x2030	12-08-2013 / 15 Mins / IF / N
8	Senior Professional Officer: Electrification	CCT/Utilities Directorate/ESD	24-04-2013/ 30 Mins / SS / R and FT
9	Head of Transport Planning and Policy Development	CCT/Transport Directorate	10/06/2014 / 30 Mins / SS / R and FT
10	Programme Manager	Sustainable Energy Africa	24-06-2012/ 30 Mins / SS / R and FT
11	Head: Green Energy	CCT/Utilities Directorate/ESD	04-12-2012/ 30 Mins / SS / R and FT
12	Director	Solarzone Pty Ltd	03-09-2013 / 20 Mins / IF / N
13	Chair: Energy and Climate Change Committee	CCT/ Energy and Climate Change Committee	15-05-2013 / 20 Mins / IF / N
14	Head: Environmental Policy and Strategy	CCT/EESP/ERMD	12-07-2013 / 30 Mins / IF / N
15	Executive: Atlantis SEZ Project	GreenCape Sector Development Agency	12-08-2013 / 30 Mins / IF / N

16	Head: Pricing and Regulation for Electricity	CCT/Utilities Directorate/ESD	16-09-2013/ 30 Mins / SS / R and FT
17	Director: SCM	CCT/Finance Directorate/SCM	20-02-2013 / 30 Mins / IF / N
18	Director: Budgets	CCT/Finance Directorate/Budgets	14-02-2013/ 30 Mins / IF / N
19	Director: Spatial Planning and Urban Design	CCT/EESP/SPUD	26-06-2013 / 30 Mins / SS / R and FT
20	Principal Engineer: Energy and Climate	CCT/ERMD/Energy and Climate Change Unit	23-08-2013 / 50 Mins / SS / R and FT
21	Head: Protection and Measurement	CCT/Utilities Directorate/ESD	16-09-2013/ 20 Mins / IF / N
22	Programme Manager: Investment Facilitation	CCT/Economic Development Department/Development Facilitation	13-03-2013 / 30 Mins / SS / R and FT
23	Head: Energy and Climate Change	CCT/ERMD	26-08-2013 / 60 Mins / SS / R and FT
24	Senior Professional Officer: Renewable Energy and Energy Efficiency	CCT/ERMD/Energy and Climate Change Unit	16-08-2013 / 40 Mins / SS / R and FT
25	Manager: Property, Environmental and Planning Law	CCT/Legal Services Department	09-04-2013 / 20 Mins / IF/ N

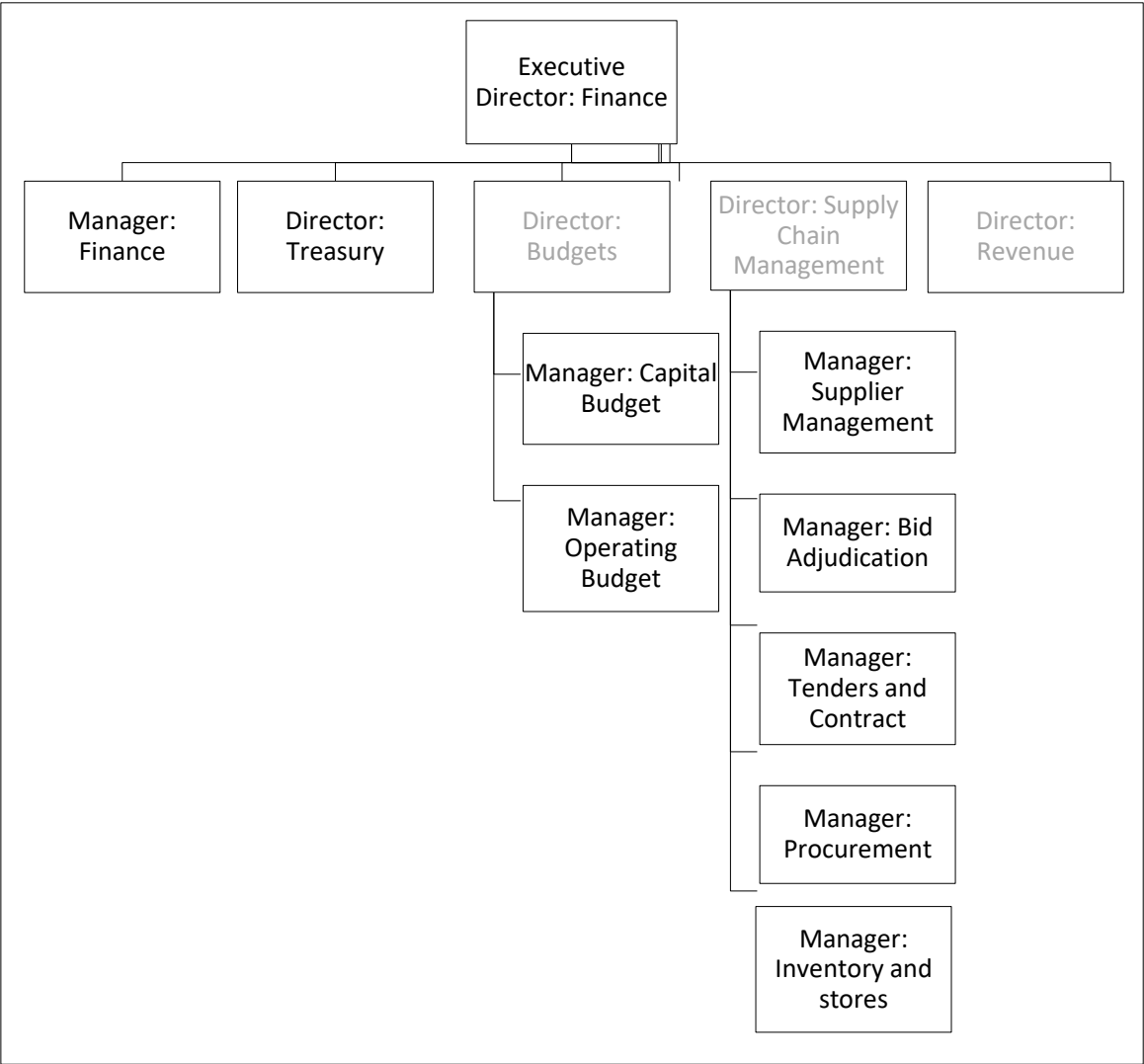
Appendix 3: Organograms of relevant City of Cape Town administrative structures

Figure 10.1: Organogram of Electricity Department



Source: Organogram developed from information on CCT, SAP Portal/eServices

Figure 10.2: Organogram of Finance Directorate



Source: Organogram developed from information on CCT, SAP Portal/eServices

## Appendix 4: Regulatory issues related to City of Cape Town's electricity regime

Table 10.1: Regulatory challenges in the City of Cape Town raised by officials

Category	Examples in City Context	Description of Challenge
Regulatory gap	Absence of technical standards for bi-directional meters	Obstacle to implementation
	Absence of technical standards or open protocols for smart meters	Obstacle to implementation
	Absence of technical standards for devices to remotely control non-essential loads	Obstacle to implementation
Unreasonable regulation	Standard Conditions (NERSA, 2011a)	<ul style="list-style-type: none"> <li>• Revenue loss</li> <li>• Not reflect cost of service</li> <li>• Not reduce peaks</li> <li>• Over burdensome</li> </ul>
	Electricity Pricing Policy (DME, 2004) (Inclining Block Tariff)	<ul style="list-style-type: none"> <li>• Revenue loss</li> <li>• Financially unsustainable</li> <li>• Difficult to administer</li> </ul>
	Compulsory Norms and Standards (DME, 2008b) (Time-of-use)	<ul style="list-style-type: none"> <li>• Lack of data of time-of-use</li> <li>• Difficult to understand tariff</li> <li>• Difficult to administer</li> <li>• Potential cash flow problems</li> </ul>
	Compulsory Norms and Standards (DME, 2008b) (Smart meters)	<ul style="list-style-type: none"> <li>• Lock in to proprietary technology</li> <li>• No open protocols or standards</li> <li>• No provision for funding</li> <li>• Limited capacity to implement</li> <li>• Unreasonable timeframes</li> </ul>
Conflicting regulation	National Building Regulations and Building Standards Act, as amended by Part XA: Energy Usage in Buildings, 2011	Conflicts with ventilation regulations
Conflicting mandates	Municipal Systems Act, 2000 conflicts with Electricity Regulation Act, 2006	Uncertainty as to whether the NERSA or Council may approve tariff



	Municipal Systems Act, 2000 conflicts with Standard Conditions (NERSA, 2011a)	Uncertainty as to whether NERSA or City has mandate to develop SSEG tariff guidelines
	Compulsory Norms and Standards (DME, 2008b)	Uncertainty as to whether City can undertake ripple control or only when System Operator directs
Regulatory uncertainty	Municipal Finance Management Act, 2003 (City must procure bulk service at least possible cost)	Uncertainty as to whether lifecycle assessments and externalities may be considered in determining least possible cost.
	Electricity Regulation Act, 2006 (Exemptions from generation licence)	Uncertainty as to whether use by City customer or wheeling to another location by same company would be regarded as 'own use'. Uncertainty as to maximum capacity that would qualify as demonstration project
Piece-meal regulation	<ul style="list-style-type: none"> <li>• Standard Conditions (NERSA, 2011a)</li> <li>• Electricity Regulation Act, 2006</li> <li>• Electricity Pricing Policy (DME, 2004)</li> <li>• Compulsory Norms and Standards (DME, 2008b)</li> <li>• National Energy Efficiency Strategy (DOE, 2013)</li> <li>• Integrated Resource Plan (DOE, 2011e)</li> </ul>	
Structural/systemic regulatory barriers	Municipal Finance Management Act, 2003 (Revenue to cross subsidise other services)	Disincentive to City support for energy efficiency and renewable energy
Divergent interpretations	Compulsory Norms and Standards (DME, 2008b)	Uncertainty as to whether municipalities can interfere with customer service
Directives with unexpected implications if implemented	Standard Conditions (NERSA, 2011a)	Revenue loss impacts
	Compulsory Norms and Standards (DME, 2008b)	Cash-flow impacts
Regulation associated with municipal functions which hinder implementation	Municipal Finance Management Act, 2003 (Appeal period)	Obstacle to implementation
	Municipal Finance Management Act, 2003 (s.78 and PPP Regulations)	Uncertainty as to process and cumbersome process

City role not considered	National Energy Efficiency Strategy (DOE, 2013)	City role not considered in achieving national targets
	Integrated Resource Plan (DOE, 2011e)	City role not properly considered
	Electricity Regulation Act, 2006	City role in generation not properly considered
Funding not considered	Compulsory Norms and Standards (DME, 2008b)	No provision for funding and risk of roll-out of smart meters and ripple control
	National Building Regulations, as amended by Part XA: Energy Usage in Buildings, 2011	Costing not considered
	Standard Conditions (NERSA, 2011a)	Lack of provision for funding meter roll out
Lack of consultation or procedurally unfair	Compulsory Norms and Standards (DME, 2008b)	Limited consultation with municipal distributors
	Electricity Pricing Policy (DME, 2004) (Inclining Block Tariff)	Formulation regarded as procedurally unfair
Financial obstacles masked as regulatory barriers	Municipal Finance Management Act, 2003 (Prohibition on ring fencing)	Other mechanisms to get dedicated budget for municipal energy efficiency
Institutional barriers masked as regulatory barriers	Municipal Finance Management Act, 2003 (Three year tender limitation)	The extension process is manageable with appropriate skills and capacity
Barriers artificially created to serve policy interests or pass the buck	Municipal Finance Management Act, 2003 (Prohibition on public expenditure on private households)	

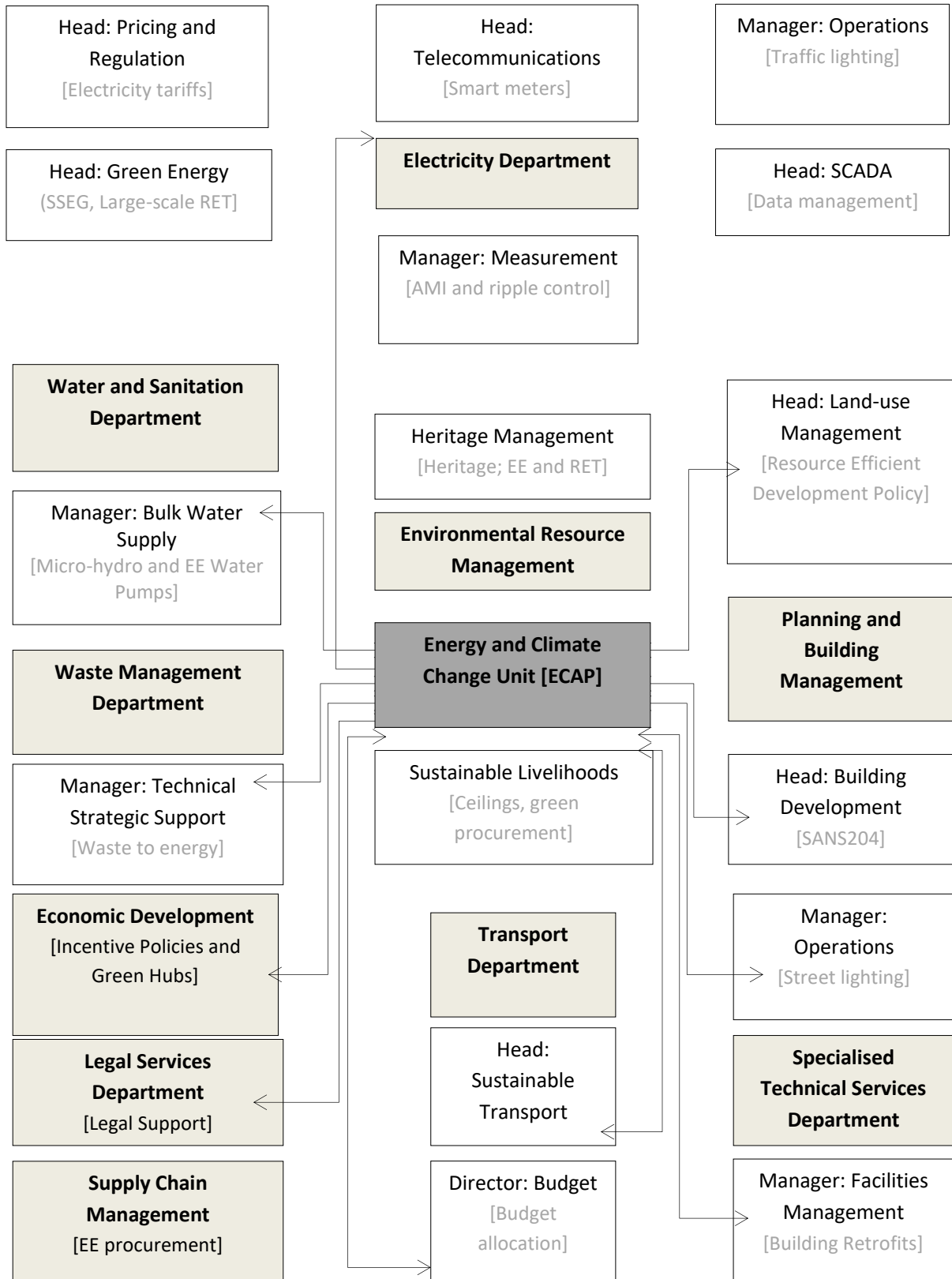
Table 10.2: Legally binding tariff principles in setting electricity tariffs

Principle	Explanation	Regulatory source
Cost reflectivity	Tariffs must reflect the costs reasonably associated with rendering the service	Municipal Systems Act, 2000 [s74(2)(iv)]
Financial sustainability	Tariffs must be set at levels that facilitate the financial sustainability of the service	Municipal Systems Act, 2000 [s74(2)(v)]
Understandable to users	Tariffs must give end users proper information regarding the costs that their consumption imposes	Electricity Regulation Act, 2006 [s16]
Cost recovery	Revenue from tariffs should reflect the full cost to supply electricity and ensure that the industry is economically viable, stable and fundable	Electricity Pricing Policy (DME, 2004) [s2.1]
Cross-subsidise poor	Poor households must have access to at least basic services through: 1) special tariffs or life line tariffs for low levels of use or consumption of services; or 2) any other direct or indirect method of subsidisation of tariffs for poor households;	Municipal Systems Act, 2000 [s74(2)(iii)]
	Local government is responsible for implementation of FBE	Free Basic Electricity Policy (DME, 2003b)
Surplus to cross subsidise other services	Municipalities shall ensure that electricity tariffs generate an operating surplus each financial year of at least 10% to finance general services and future expansion of services	Municipal Finance Management Act, 2003
Surcharges	A municipality may impose surcharges on fees for services provided	Constitution, 1996 [s229(1)]
Predictable and stable	Tariffs should prevent price shocks and keep customers informed about future price trends	Electricity Pricing Policy (DME, 2004) [s2.1]
Fair (equitable)	Users of municipal services should be treated equitably in the application of tariffs	Municipal Systems Act, 2000 [s74(2)(i)]
	A tariff policy may differentiate between categories of users and geographical areas as long as it does not amount to unfair discrimination	Municipal Systems Act, 2000 [s74(3)]
Transparent	Full disclosure of cost (no hidden charges). Cost should be unbundled. Tariffs should be easy to understand and apply	Electricity Pricing Policy (DME, 2004) [s2.1]
Incentivise efficient use of resources	The economical and efficient use of resources, recycling of waste, and other appropriate environmental objectives must be encouraged	Municipal Systems Act, 2000 [s74(2)(viii)]
	Tariffs should promote overall demand and supply-side economic efficiency, and be structured to encourage sustainable, efficient and effective use	Electricity Pricing Policy (DME, 2004) [s2.1]
Socio-economic objectives	Provision may be made for the promotion of local economic development through special tariffs for categories of commercial and industrial users	Municipal Systems Act, 2000 [s74(2)(vii)]

Service improvements	Prescribe incentives for continued improvement of the technical and economic efficiency with which services are to be provided	Electricity Regulation Act, 2006 [s16]
	Expansion through development of least cost options in line with national resource planning	Electricity Pricing Policy (DME, 2004) [s2.1]
	Tariffs should be simple to administer and elegantly aligned to municipal billing, metering and communications systems	Practice
Reasonable and defensible	Tariffs must be reasonable and defensible	Municipal Systems Act, 2000
Extension to unserved and new customers	Universal access to electricity and municipal electrification of unproclaimed areas.	Policy guidelines for Electrification of un-proclaimed areas (DOE, 2011f)

## Appendix 5: Urban energy and climate governance in Cape Town

Figure 10.3: Nodes in the City of Cape Town engaged in electricity reconfiguration



*Table 10.3: Organisations in Cape Town engaged in energy reconfiguration interventions*

Category of organisation	Organisation	Involvement in implementing transition interventions
<b>City of Cape Town departments and units</b>	Electricity Department	Policy development and implementing agent
	Facilities Management	Policy development and implementing agent
	Transport Directorate	Policy development and implementing agent
	Supply Chain Management	Implementing agent and procurement
	Budget Department	Budget allocation for implementation
	Planning and Building Development	Policy development and implementing agent
	Executive Management Team	Transversal application of policy and implementation
	Energy Committee	Political oversight of policy and implementation
<b>Not for profit organisations</b>	Sustainable Energy Africa	Policy development and implementation support
	GreenCape	Align implementation with economic development opportunities
	Electricity Governance Initiative	Policy development
<b>Academic institutions</b>	Energy Research Centre	Policy development, strategic research and M&E of implementation
	Centre for Renewable and Sustainable Energy Studies (SU)	Strategic research, knowledge exchange, co-production
	African Climate and Development Initiative (UCT)	
	Climate Systems Analysis Group (UCT)	
	Sustainability Institute (SU)	

<b>Local government associations and umbrella organisations</b>	Global Risk Governance (UCT)	
	Environmental and Geographical Sciences Department (UCT)	
	South African Local Government Association	
	Association of Municipal Electricity Undertakings	Knowledge exchange, strategy development and bargaining position of cities
	South African Cities Network	
<b>National government</b>	City Energy Support Unit	
	Department of Energy	Policy and EEDSM allocations
	National Energy Regulator	Regulation and guidelines
	Department of Public Enterprises – Eskom	EEDSM and partnerships
<b>Provincial government</b>	Department of Environmental Affairs and Development Planning	Alignment of policy and projects
	Department of Economic Development and Tourism	Alignment of policy and projects
<b>Donor organisations</b>	British High Commission	
	Danish International Development Agency	
	United Nations Environment Programme	Funding for project implementation and policy development. Some donor organisations also provide technical support
	Konrad-Adenauer-Stiftung	
	Humanist Institute for Cooperation with Developing Countries	
	Energy and Environment Partnership	
	Renewable Energy and Energy Efficiency Partnership	
<b>Partnerships</b>	Cape Town Partnership	
	Accelerate Cape Town	Pool resources, exchange knowledge and align implementation
	Cape Town Chamber of Commerce	
	Energy Efficiency Forum	

*Table 10.4: City of Cape Town's role in incubating green energy infrastructure*

<b>Green energy infrastructure</b>	<b>Models of support City of CT investigating and pursuing</b>	<b>City of CT's role in incubating niches against regulatory and economic barriers</b>
Renewable energy	Renewable energy portfolio standards	City of CT target for 20% renewable energy by 2020
	Feed in tariffs	Feed in tariff for SSEG
	PPAs (anchor customer or off take agreement)	City of CT pursuing power purchase agreement to give assurance to IPP of demand for their generation.
Building retrofits	Performance or guaranteed savings contracts	Overcomes upfront costs of retrofits and provide ESCO with contract
Solar water heaters	Billing and endorsement schemes and loan financing	Upfront costs and knowledge (public has lack of certainty regarding reliable suppliers - endorsement)
Energy efficiency	Rebates	Upfront costs and save need for supply expansion
	Tax incentives	Help Cape Town-based companies unlock energy efficiency tax incentives
	Support carbon projects and tax	Draft Carbon Policy
	Procurement	Greening SCM policies
	Require SABS approval in endorsement schemes	Means to reduce customer uncertainty
Lighting	Return/replacement schemes	Help CT-based commercial, industrial and residential unlock replacement schemes.
Efficient development	Standards (Part XA) and development assessment system (REDP)	Proper implementation of national standards and formulation of land use planning policy
Pump storage and peaking plants	Pump during low tariff and generate during high tariff	Buffer against national capacity constraints and monetary savings
	Building peaker plants	Buffer against national capacity constraints
Ripple control	Smart meters	Support development of technology
Geyser timers	Requirement for endorsement	Support geyser timer deployment through making criteria in SWH endorsement
Ceilings	Legal requirement for all developments	Retrofits and support national efficiency standards



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